THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK NOVEMBER, 1906

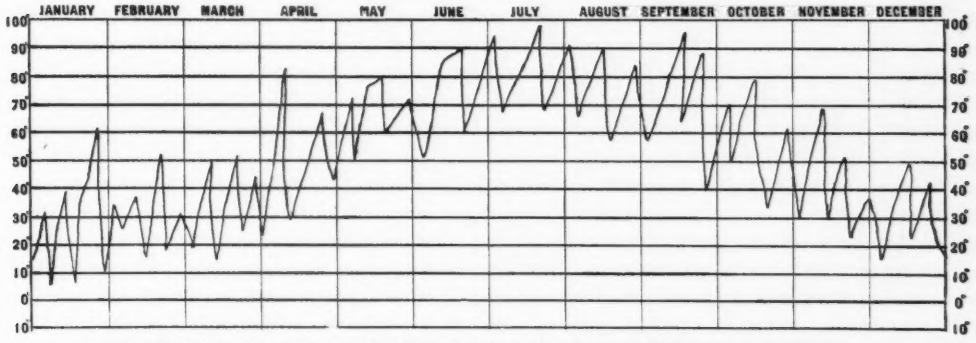
A Decade of Weather in New York City

Compiled for The Heating and Ventilating Magazine from Daily Observations for the Years 1887-1898

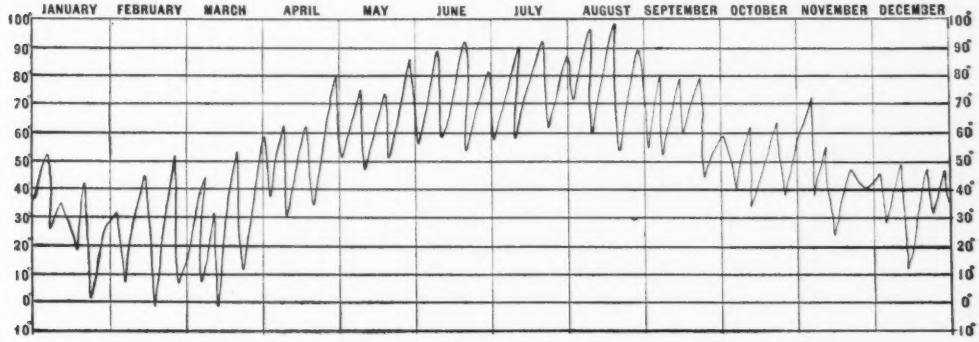
In the August number of THE HEATING AND VENTILATING MAGAZINE was published a chart showing the daily fluctuations of the temperature in New York City during the heating season of 1904–5. The records for that season were taken as they were found to be fairly representative of those of the weather in New York for the past ten years.

The chart was especially noteworthy as indicating the rarity of zero temperatures in New York or temperatures even approximating zero. Only once, for instance, during that season did the temperature fall to zero and only three times did it go down as low as 5°.

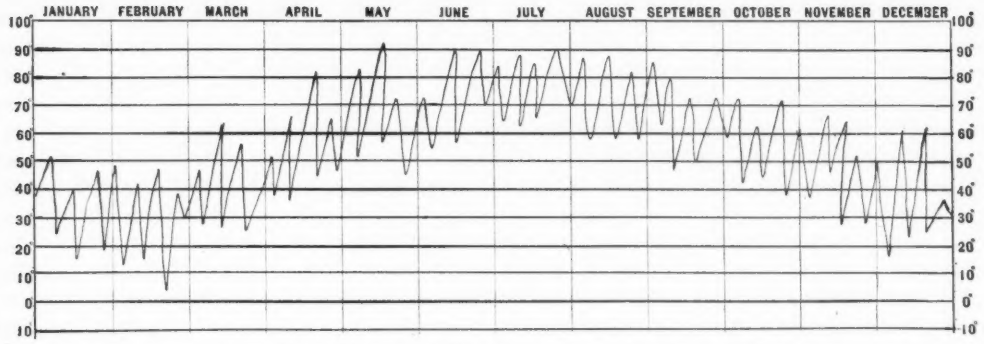
In order to still further test the accuracy of this information, an examination was made of the temperature records for ten years preceding those from which the above-mentioned data was obtained. This examination carried us back to the year 1887, and the results of the investigation are presented in the following charts.



VARIATIONS IN THE TEMPERATURE IN NEW YORK CITY DURING 1887



VARIATIONS IN THE TEMPERATURE IN NEW YORK CITY DURING 1888



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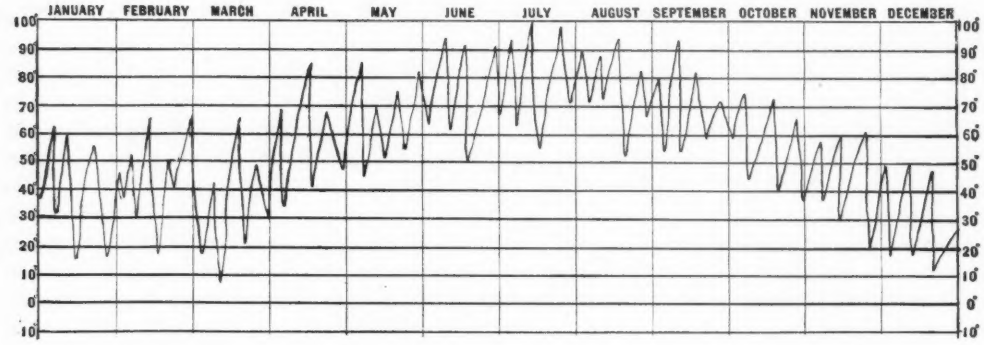
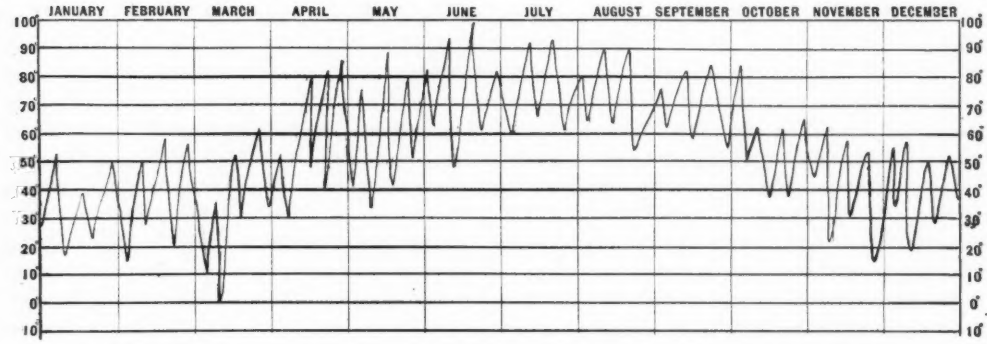


VARIATIONS OF THE TEMPERATURE IN NEW YORK CITY DURING 1890



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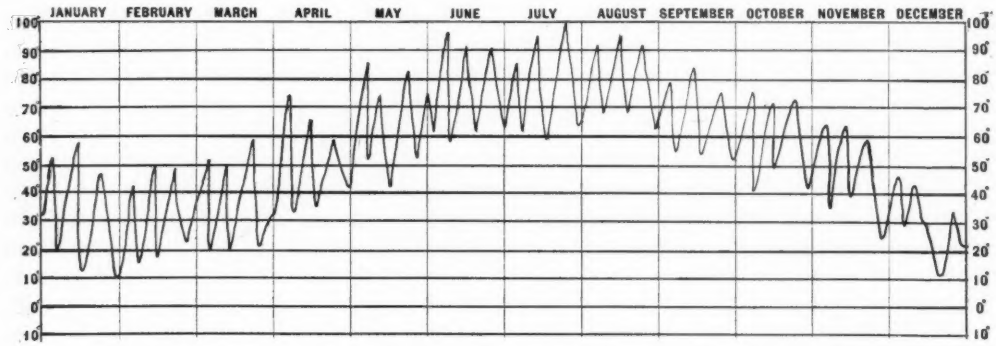
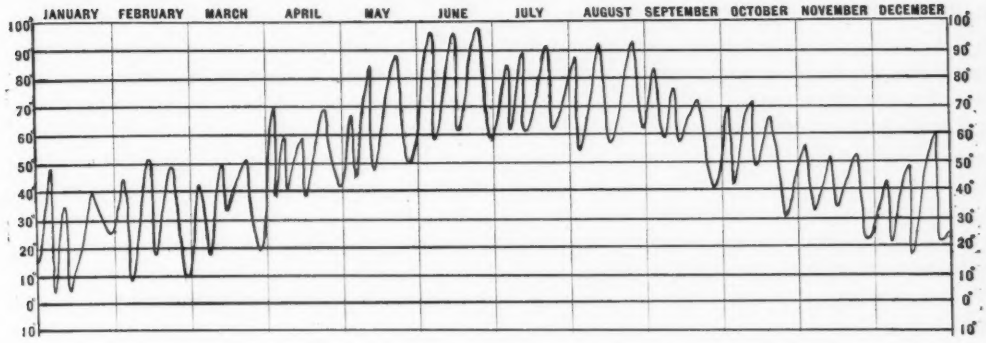


VARIATIONS OF THE TEMPERATURE IN NEW YORK CITY DURING 1892



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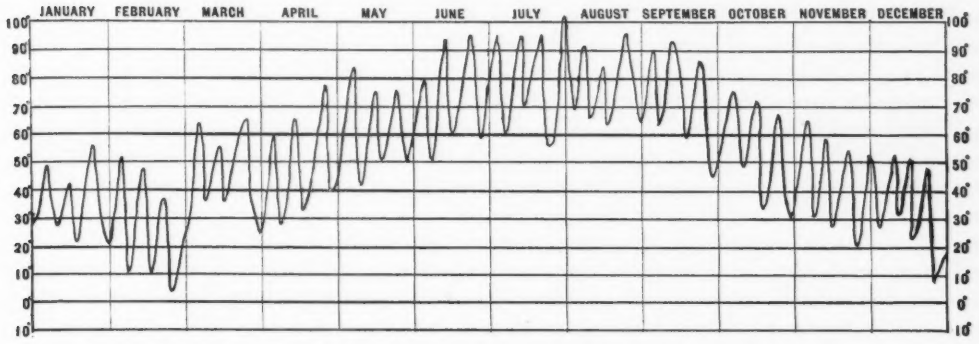
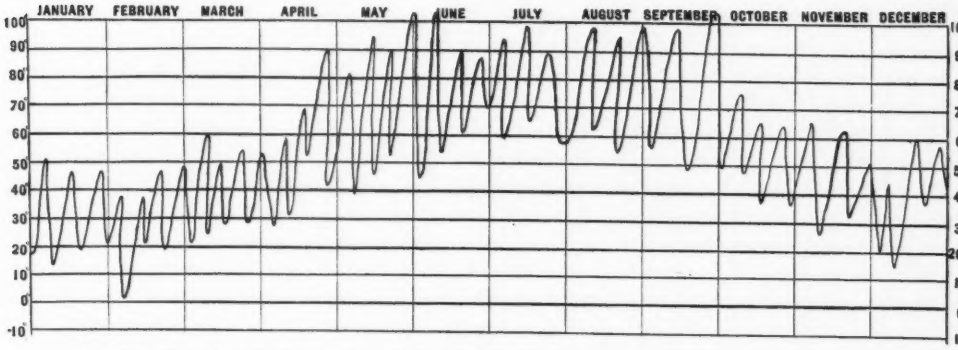
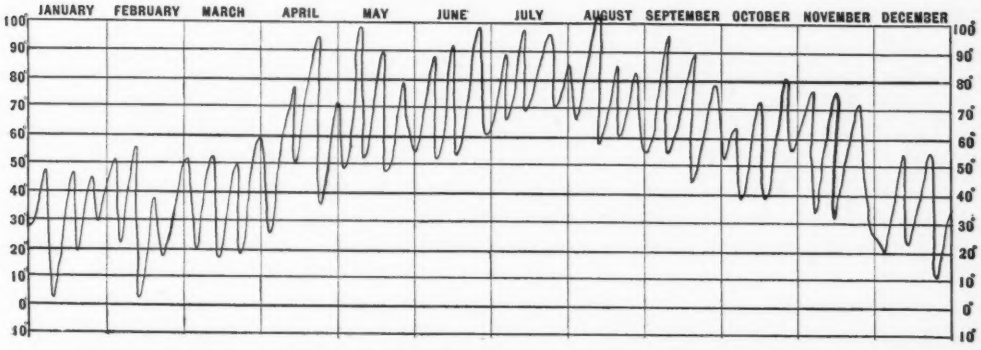


VARIATIONS OF THE TEMPERATURE IN NEW YORK CITY DURING 1894

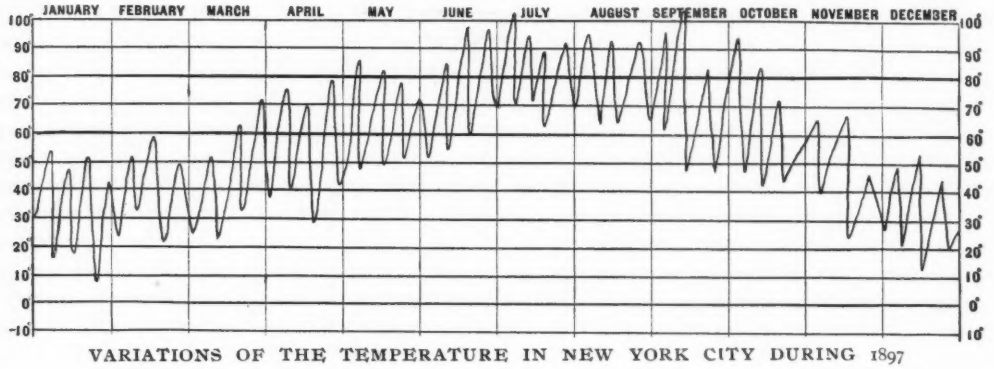


VARIATIONS OF THE TEMPERATURE IN NEW YORK CITY DURING 1895



VARIATIONS OF THE TEMPERATURE IN NEW YORK CITY DURING 1896

It should be stated that these charts are plotted from figures giving the temperature every three hours during the entire period of over ten years and, as it was impossible to show every change, it was decided to note the high and low temperatures as they occurred during the months



VARIATIONS OF THE TEMPERATURE IN NEW YORK CITY DURING 1897

and it is these temperatures that are shown graphically on the charts. In other words, no temperatures, high or low, occurred during any month that are not indicated by the lines.

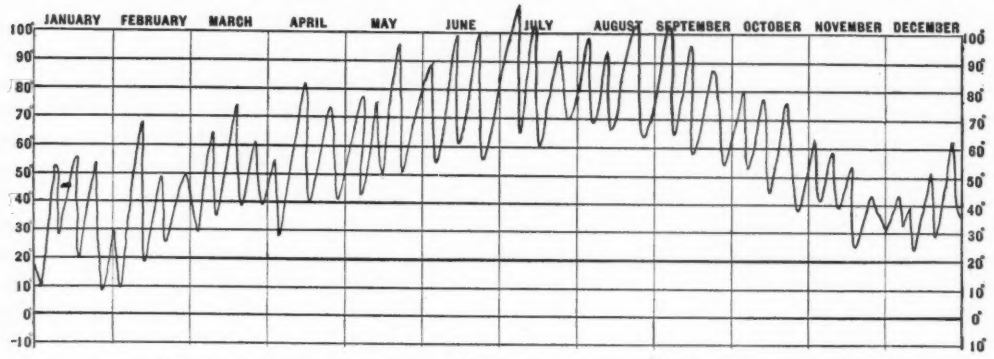
The records bear out to a surprising degree information previously noted that a temperature of 10° F. seldom occurs in NewYork City and that the effect of wind velocities deserves more attention than it has been receiving.

On noting the conditions attending the variations for the various years, there is considerable data which should supplement the information as given on the charts. Some of the more notable features are presented herewith by years.

1888.

This was the year that produced the famous blizzard. The maximum velocity of wind attained March 13th, the second day of the blizzard, was 50 miles and the total number of miles traveled by the wind during the month was 10,470, the greatest of the entire year. The snowfall during the blizzard was 2½ feet on the level.

The following December was remarkably warm and the 25th was the warmest Christmas day in 18 years. The average temperature during the heating season was January, 26°; February, 32°; March, 32°;



VARIATIONS OF THE TEMPERATURE IN NEW YORK CITY DURING 1898

April, 47°; May, 58°; October, 49°; November, 45°; December, 34°.

1889.

This year was notable for its warm December, the mild weather lasting over Christmas. It was the warmest December in 19 years.

1890.

The warm season of the previous December extended well into Janu-

ary, the average temperature for the month in New York being 40°. There was no parallel of this weather in the previous 20 years. On March 18th, six inches of snow fell. In December, there were two periods of low temperatures and high gales, with heavy snow on the 26th.

1892

The first three months of this year were notable as being above the average in mildness.

1893

During the first two months of this year, the temperature remained lower for a longer length of time than ever before. For 55 days in succession the temperature went below the freezing point. A temperature of 40° was recorded September 26th.

1894

On February 11th, a record breaking blizzard occurred, with a low temperature of 21°. December 28th of this year was the coldest since 1880. The temperature was 8°.

1895

February 4th was the coldest Feb. 4 in 14 years, 2° above zero. On February 12th, 5½ feet of snow fell, with the wind blowing 60 miles an hour. Temperature 1° above zero. April 25th was the hottest day in 24 years, the mercury rising to 90°.

1896

January 5th was the coldest Jan. 5 in 15 years, 2° above zero. This record was reached again on February 17th. On March 16th, 11 inches of snow fell. A high record temperature for April of 95° was recorded on April 16th.

1898

March was a record-breaking month for gales and rainfall, the precipitation totaling 6.70 inches.

The Schoolhouse—Its Heating and Ventilation

By Joseph A. Moore,
Inspector of Public Buildings, State of Massachusetts

Steam Pipes and Radiators

VI

(*This Series of Articles Commenced in Our April, 1906, Number*)

The success of a steam-heating apparatus will to a considerable extent depend upon the proper size, location, grading, dripping and valving of the steam pipes.

In the earlier instalment of gravity systems of steam heating in schoolhouses trouble was often caused by the use of too small pipes, both for supply and return. At the present time larger pipes are used and much better results are obtained.

In piping indirect radiators the following may be considered a safe rule for size of supply and return pipes when a gravity system is used and steam supplied at low pressure, five pounds or less.

Square Feet of Indirect Radiators.	Supply. In Inches.	Return. In Inches.
30 or less	1	¾
30 to 50	1¼	1
50 to 100	1½	1¼
100 to 160	2	1½

It is not advisable to make indirect radiator stacks with more than 160 square feet of radiating surface, and 140 is to be preferred to 160 if good circulation is expected. Three-quarter-inch pipe is the smallest that should be used for return, even from very small radiators. For indirect steam heating the supply pipes should have double the area in cross section of those supplying direct radiators.

For direct radiation steam mains and risers the rule adopted by many heating contractors is one-tenth the square root of the heating surface in square feet for the diameter of the supply pipes in inches; or, square the diameter of the pipe in inches for the number of hundred feet of direct radiation it will supply.

By using pipe one size larger than that called for by these rules better results will be obtained. Another rule is to divide the amount of direct heating surface in square feet

by 100, divide the quotient by .7854, then extract the square root of the quotient; the result will be the diameter of the pipe in inches.

As a general rule, return pipes should be one size smaller than the supply pipes, but with large supply mains this may be considerably reduced.

By using large and well-covered pipes satisfactory results will be obtained. Too frequently, in order to reduce the cost, pipes of too small diameter are used, especially for indirect steam heating.

The supply pipes in the basement of a schoolhouse should be well covered with a neat non-heat-conducting covering, and although the first cost will be increased, yet the results therefrom will fully compensate for the additional expense.

Care should be taken that the steam pipes are properly pitched, dripped and valved in order to secure free and noiseless circulation and return; that they are properly supported on roller pipe hangers and proper allowance made for expansion and contraction.

The main return pipes should be provided with proper check valves and shut-offs. Valves for controlling vent flue heating should be placed in the basement. Every radiator, heating coil or stack should be fitted with a supply valve, return valve and automatic air valve properly located. Gate or angle valves are to be preferred to globe valves. Overhead pipes for heating the basement should be properly valved, pitched and of such form as to provide for expansion and contraction, and hung from the floor timbers of the first story with securely fastened roller pipe hangers about every eight feet.

Where circulation pipes are placed on the walls the pipes should be well straightened and secured to the wall by hook and expansion plates, fastened to wooden strips placed not more than ten feet apart, and ample provision made for expansion and contraction.

Rising main and return pipes should be straight and parallel, properly valved and dripped, and where pipes pass through floors they should be incased through the full depth of flooring and ceiling in tin tubes with flanged iron plates screwed to the floor, and with iron ring plates or flanges securely fastened to the ceiling. Where pipes pass through wooden partitions tin sleeves and flanged plates should be used and if through brick walls, metal collars should be provided. Where practicable, return pipes should be laid in a properly graded brick trench having a covering of cast iron plates or bluestone flagging.

Where several vertical return pipes enter the main return they should in all cases be carried well below the water line in the boiler before they unite into one pipe.

By proper arrangement of pipes and radiators in a low pressure gravity return system the condensation may be easily and noiselessly returned to the boiler without the use of traps or pumps.

For piping connections it is advisable to use eccentric fittings.

A two-pipe, low pressure, gravity return system of steam heating is to be preferred for schoolhouses of small or moderate size. In large buildings a double mechanical system (one having a fan supply and fan exhaust), or a combination of fan (or plenum) supply and gravity exhaust, is to be preferred.

Where a mechanical system is used, the exhaust from the engine should also be used for heating. A mechanical system will require the use of fans, engine, pumps or traps, governor, tanks, steam separator, reducing valves, exhaust head, vapor pipe, etc.

A blow-off tank, properly connected with a dry well or sewer and properly trapped, should be provided in all cases where practicable. A valve or cock should be provided at the lowest place in the system to draw off the water when desired.

RADIATORS

In the earlier attempts to venti-

late school buildings by indirect radiation many failures occurred on account of an insufficient amount of radiation and improperly locating and casing it; not allowing sufficient space between the sections for a liberal quantity of air to pass, too small steam supply and return pipes, and not providing adequate means for regulating the temperature of air passing the radiators.

It has been found in actual practice (and the schoolrooms in Massachusetts are now generally heated accordingly) that to secure the best results under varying conditions of temperature and wind 400 square feet of cast iron radiating surface should be supplied for an ordinary schoolroom 28 by 32 by 12 feet, if situated where there are two cold exposed walls and where ample window space to give good light is provided.

This should be divided into three stacks, one of 100, one of 140 and one of 160 square feet; or one of 120 and two of 140 square feet each, each stack to be separately piped and valved, in order that one, two or three sections may be used as needed, according to the outside temperature. The 100-foot section should be placed nearest the uptake warm air flue.

Where there is but one exposed wall, and on the southerly side, 380 square feet may be used and divided into three stacks, one of 100 and two of 140 square feet each.

Cast iron radiators having an extended surface, and with not less than one-half-inch space between the ends of the pins or ribs of the several sections, are now generally used in Massachusetts schoolhouses.

While coils or radiators made of steam pipes are the most efficient radiating surfaces, yet, on account of the cost and the facility of constructing the indirect radiator stacks, cast iron is now generally used with gravity systems.

It is better to use a deep radiator than to double bank or place one section above another. Cast iron extended surface radiators having 20 square feet of radiating surface per section give very satisfactory results.

The sections are 36 inches long, 15½ inches high and connected four inches from center to center of the sections, tapped for two-inch supply and return pipes, and have right and left nipple connections. The air valve measures ⅜ of an inch.

When more than one schoolroom receives its warm air through radiators in the same cold air room the radiator stacks for each room should be separated by galvanized iron divisions extending about 20 inches below the bottom of the stacks. Where this is not done, and two or more rooms receive air from the same cold air room, the results are very unsatisfactory, as one room may receive much more than its fair proportion of heat and air at the expense of another. The galvanized iron casings for indirect radiators should be made on number 20 or 22 gauge iron, and be well stiffened at the edges and corners.

When rooms in different stories of the building receive their air supply from the same cold air room the radiators for the first story should be placed nearest the cold air window, in order that they may have an advantage in receiving air in preference to the rooms in the second or third stories.

The supply and return pipes for the indirect radiators should be well protected in all cases where they come inside the cold air rooms with first-class pipe covering.

The valves should always be placed outside the cold air rooms.

The air valves give better results when placed in the quarter turn or elbow where the return changes to a downward direction than when placed in the radiator itself, as is usually done where direct radiators are used.

The bottom of the radiators should not be cased, but left entirely open, as much more even distribution of air is obtained.

In the earlier indirect radiator work it was customary to inclose

the radiators on all sides and bring the air in at one end of the bottom of the casing, taking it out at the top of the opposite end. This does not give as good results, or utilize the whole of the radiator surface, as well as when the bottom is left entirely open and a cold air room is provided. Under some conditions, when the first method is used, there is a reversed or back draft, and the writer has frequently found warm air going out of the building through what was intended to be the cold air supply opening.

Better results are obtained when a tall radiator is used than when the stack is made long and low.

DESIGN FOR DIRECT-INDIRECT RADIATOR

In the accompanying illustration is shown a direct-indirect radiator, designed by the late John T. White, which has been successfully used where a full supply of air is not required by indirect radiators. It is cased and inclosed in a manner that insures a better utilization of heat than is possible with the common style of direct-indirect radiators.

This radiator is designed to be used in small halls or in churches, where it may be easy to provide for a strong exhaust leg of a ventilating system, but difficult to arrange for a straight indirect method of heating and supplying air.

Almost any good direct radiator may be used or a coil of pipe.

The radiator is first cased in metal, and may then be finished in wood in any way desired.

The fresh air opening has an area of two square inches for each square foot of radiation; but the supply of air from outside may be controlled by damper, as shown, which can be held in any position. The inside damper is always to be entirely open or shut. When open, the air is taken from the room, and the effect is, of course, nearly the same as with a direct radiator.

Such a radiator with 100 square feet of surface has been found to furnish 500 cubic feet of air per minute under fairly favorable conditions.

The fresh air opening, extending nearly the entire length of the stack, gives a more even distribution of air to the heating surface than (as is generally the case) where the opening is near the center of the stack and the area is obtained by one which is high and short instead of low and long, as shown in this design.

In many schoolhouses lines of 1¼-inch steam pipe are placed on the outside walls of the rooms, and are used at night and before the school session opens to quickly warm the rooms. In rooms occupied but a part of the time, such as assembly halls and laboratories, etc., this is a good provision and saves fuel, but they should not be used in schoolrooms while schools are in session.

Direct radiators are often used to good advantage in schoolhouse corridors and in teachers' rooms.

In basement rooms the heating should be by overhead lines of 1¼-inch pipe, unless a room is used as a manual training room or for a similar purpose, in which case a moderate supply of air from indirect radiators can be introduced near the ceiling.

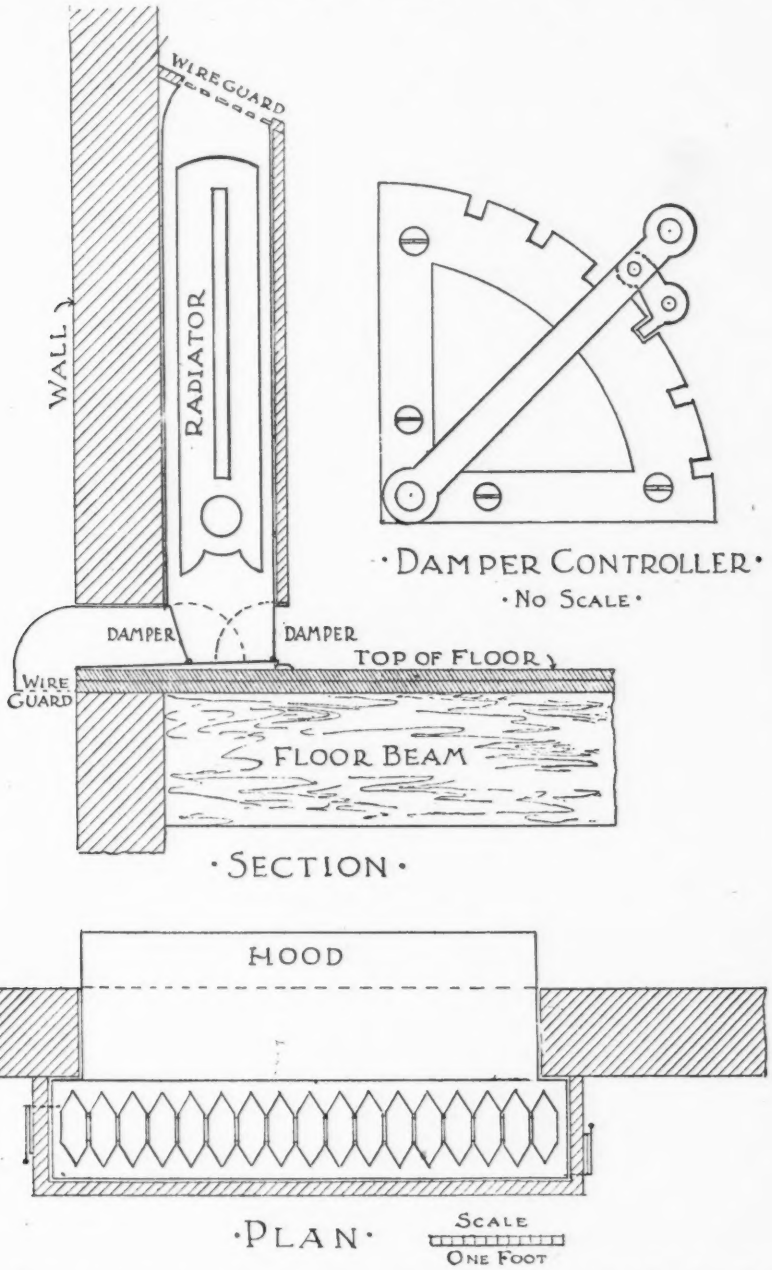
In using wall or ceiling pipes special attention should be given to properly provide for expansion and contraction.

There should be at least two feet distance between the bottom of the radiators and the water line in the boiler to secure a good return of the condensation from the radiators. If a greater distance can be had it will be better, and danger of filling the radiators with water will in a great measure be prevented. The writer has seen cases where an otherwise well-designed system of heating has been spoiled by not allowing sufficient distance between the bottom of the radiators and the water line in the boiler.

ARRANGEMENT OF RADIATORS FOR USE AS FOOT-WARMERS AND FOR WARMING CORRIDORS

A method is shown herewith of arranging radiators to be used as

foot-warmers and for warming the corridors. Six sections of indirect cast iron pin radiators are made into a stack containing 120 square feet of radiating surface, which is suspended below the basement ceiling on two 1½-inch iron pipes, which are secured to the floor timbers above by iron hangers. The sections are 15½ inches high at their highest part and 36 inches long. The pins are one inch long and the sections are set up four inches on centers with one-half inch space between the ends of the pins.



DESIGN FOR DIRECT-INDIRECT RADIATOR

USED WITH SUCCESS WHERE A FULL SUPPLY OF AIR IS NOT REQUIRED BY INDIRECT RADIATORS

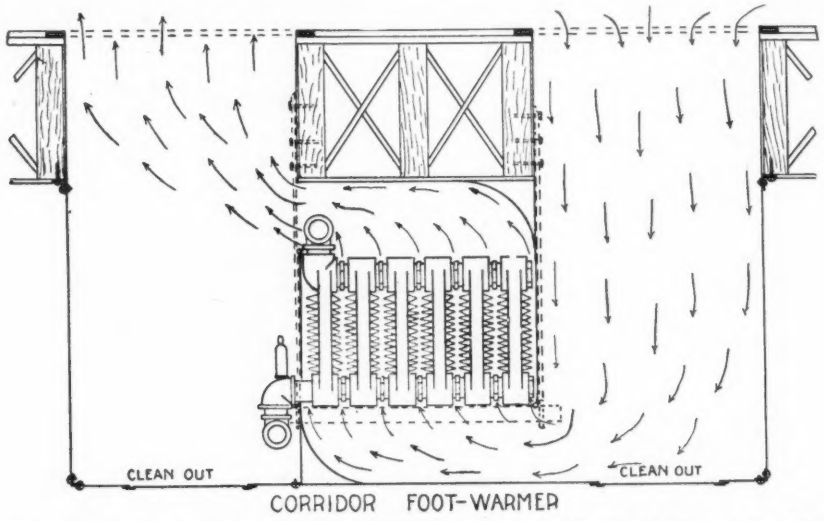
Two-inch right-and-left nipples are used for connecting the sections, which are tapped for two-inch supply and return. A ⅜-inch air valve is placed in the quarter-turn or elbow of the return. This air valve is placed in a position, where, should it be desirable to moisten the air, a small quantity of steam may be allowed to escape through the air valve.

The casing is of twenty-four gauge galvanized iron put together with screws, nuts and angle iron, so that it may be easily removed should it be required to make repairs on the heating stack. In the bottom of the casing are two clean-out slides for removing any dirt or substance that may fall through the register gratings in the door of the corridor.

The air is taken from the corridor down on one side, passes under and up through the radiator stack and ascends to the corridor through another register in the corridor floor.

This arrangement prevents the accumulation of dirt and various substances that would fall on the heated radiators through a register placed directly above the heating stack.

Very satisfactory results are obtained when two lines of 1¼-inch steam pipe are placed near the floor in the corridor and under the clothing racks.



ARRANGEMENT OF RADIATORS FOR USE AS FOOT WARMERS AND FOR WARMING CORRIDORS

APPROXIMATE RULE FOR ESTIMATING AMOUNT OF INDIRECT RADIATION

For a fifty-seat schoolroom of the ordinary size (28 by 32 by 12 feet) with a gravity system of heating and ventilation, using a good indirect radiator with ample flues, etc., and natural draft, is as follows:

50 (number of pupils) × 30 (cubic feet of air per pupil per minute) = 1500 (cubic feet of air per minute).

1500 (cubic feet per minute) × 60 (minutes per hour) = 90,000 cubic feet of air supplied per hour.

Air at zero to be warmed 105 degrees F. 90,000 (cubic feet) × 105 (degrees) = 9,450,000 cubic feet of air warmed one degree. 9,450,000 (cubic feet) ÷ 50 (cubic feet warmed one degree by one heat unit) = 189,000 heat units. 189,000 (heat units) ÷ 1,000 (heat units available per pound of steam) = 189 pounds of steam condensed to water. 189×2=378 square feet of radiation. In actual practice from 380 to 400 square feet of cast iron indirect radiation is used per room. This allowance is made on account of overrating the square feet of surface in radiators by the manufacturers, for air leakage in rooms and to

meet the requirements in exceedingly cold weather.

While this may not be an approved scientific method of calculating indirect radiation, and may by some be called a "rule of thumb," yet in actual practice it has given excellent results and may be considered as safe as some more scientific and theoretical formulas.

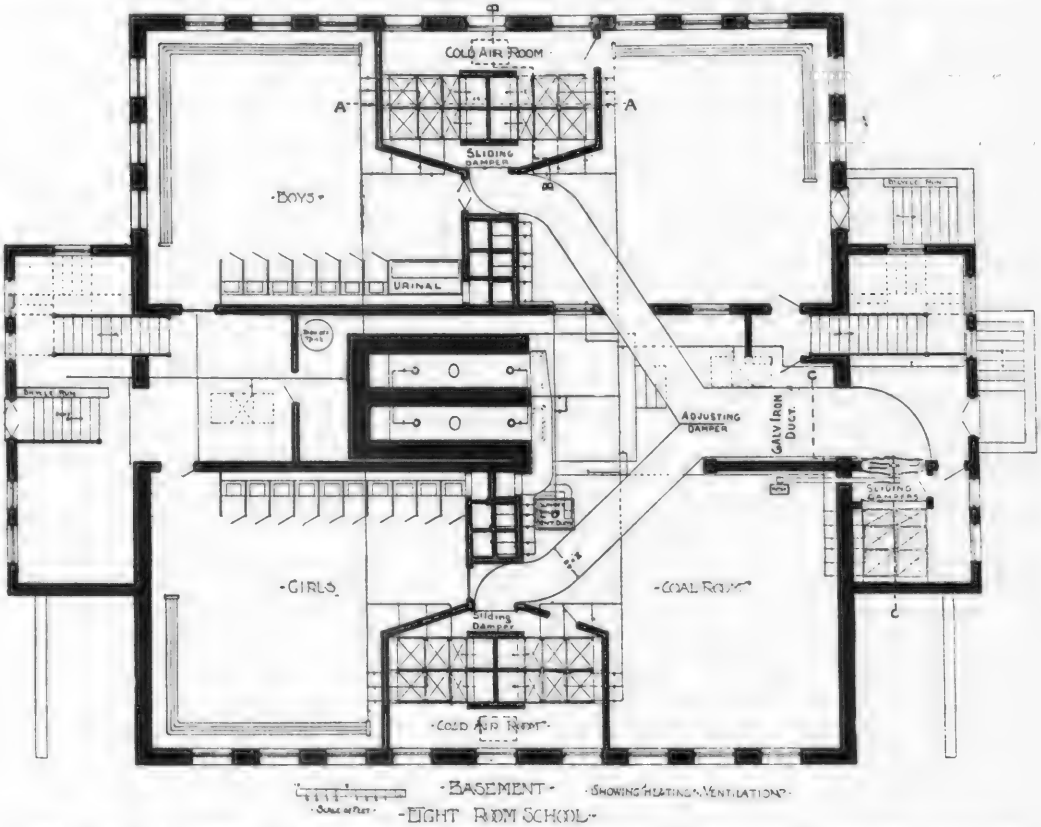
AUTOMATIC HEAT CONTROL

The first attempts to automatically control mixing dampers were generally complete failures. A device that opens wide or closes tight the mixing damper changes the temperature from all warm to all cold air, and uncomfortable drafts are the result.

The writer has seen cases where the temperature of the incoming air was changed from over 100 degrees F. to less than 30 degrees F. in less than four minutes when the mixing damper was automatically operated. When the damper was again moved the temperature would rise to the high point in but little over five minutes. This was especially noticed when a strong wind was blowing into the cold air room. When the mixing damper is moved to entirely shut off the warm air, except what little leaks through the narrow spaces on the sides and top of the mixing damper, the radiators, if steam is used, soon become cold, and the cold air from outside passes up directly into the schoolroom. With furnaces the results are not any more satisfactory.

When the mixing damper is moved slowly by the automatic control, but is opened wide or fully closed, the results are not satisfactory.

The managers and agents of some automatic heat controlling systems frequently guarantee that the mixing dampers or the valves controlling the heat supply steam pipes

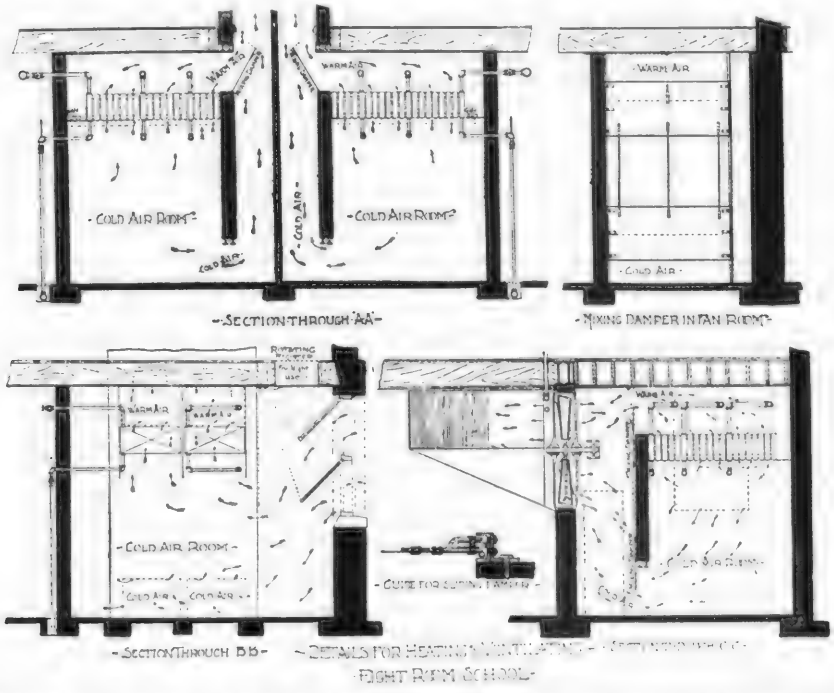


PLAN OF BASEMENT IN EIGHT-ROOM SCHOOL, SHOWING HEATING AND VENTILATING SYSTEM

will be operated by one degree or less change of temperature, as indicated by the thermometer attached to the thermostat. While this is true in many cases, yet it does not give satisfactory results at all times. When the cold air is admitted by the mixing damper, or the steam valves to the indirect radiators are shut, the radiators are soon cooled and uncomfortable drafts are felt, and as the thermostats are often placed where they are not easily and quickly acted on by the incoming air, the drafts continue. After hand control has been used on the valves of different sections of the indirect radiators, more satisfactory results have been obtained than when used on mixing dampers.

By dividing the amount of indirect radiation for a schoolroom into three sections and using hand valves on two, and automatic on one section, better results are obtained than where the automatic is used on all three sections.

Automatic control is sometimes used on the supplementary radiation in mechanical systems where



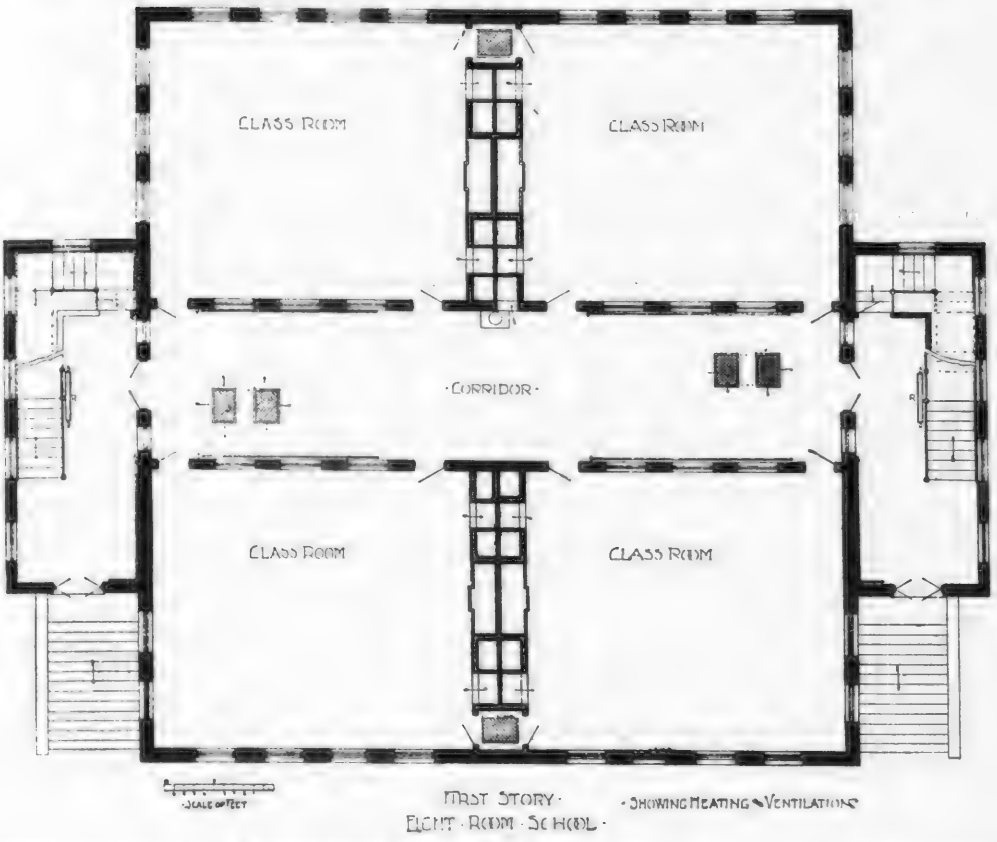
DETAILS OF INDIRECT RADIATORS AND COLD AIR ROOMS IN EIGHT-ROOM SCHOOL

the steam has been again turned on by opening the valves, time is required for the radiators to again become warm enough to give off sufficient heat to properly warm the incoming air, the cold drafts will continue until the incoming air has changed the temperature at the thermostat enough to operate the valve or damper controlling device. This is often several minutes after the valves have been opened.

Where automatic control has been used on direct radiators, or where a combination of automatic and fans or blowers are used. If it is to be used in a mechanical system the results will be better if the primary coils or stacks are provided with all or nearly all hand-controlled valves, and the automatic used on the supplementary coils or stacks or direct radiators or wall coils, if such are provided.

When used on hot water radiators the change of temperature is not as rapid as with steam radiators.

The accompanying plans are those for a two-story, eight-room,



FIRST FLOOR PLAN IN EIGHT-ROOM SCHOOL, SHOWING LOCATION OF CORRIDOR REGISTERS AND HEATING AND VENTILATING FLUES

brick school building, showing the heating, ventilating and sanitary appliances.

A combination of the gravity and mechanical systems of heating and ventilation is used.

In the gravity system there are 400 square feet of indirect cast iron heating surface for each schoolroom. This is divided into stacks of 100, 140 and 160 square feet for each classroom, separately piped and valved, in order that either a part or the whole can be used as desired, and is sufficient to meet the requirements of heating and ventilation in the coldest weather that occurs in Massachusetts.

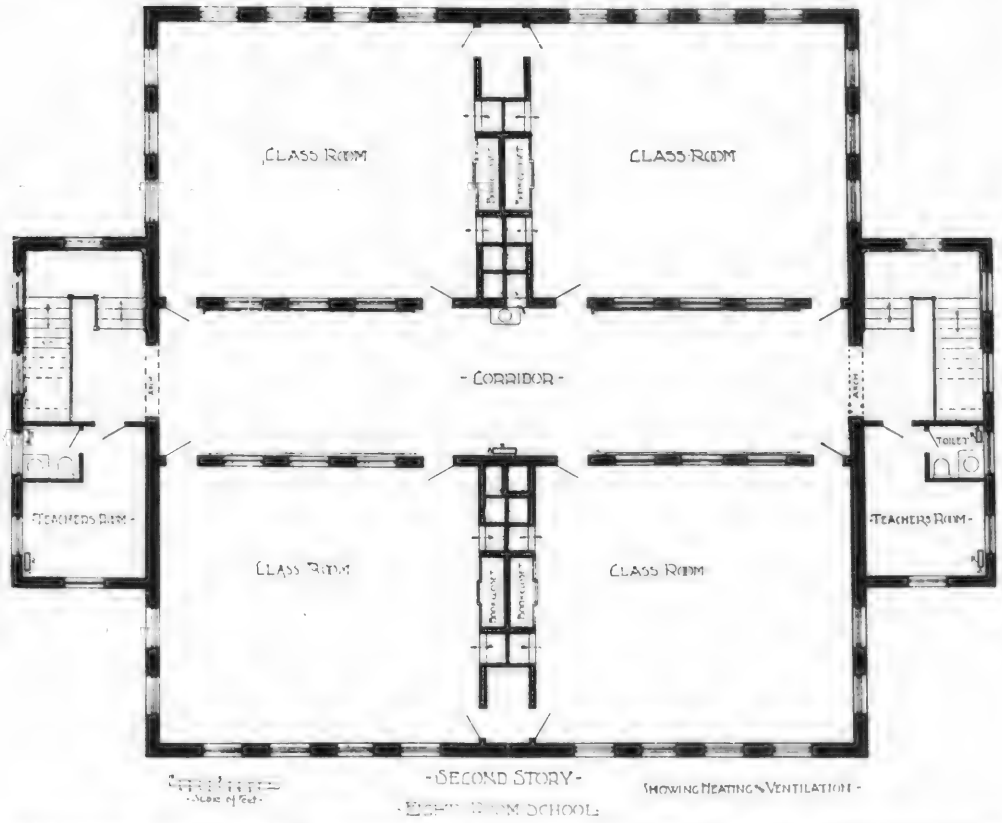
Fresh air is admitted through the windows in the two cold air rooms in the basement, when the gravity system is in use (the ducts leading from the fan being then closed) in cold weather, when the difference between the inside and outside temperature is sufficient to furnish a full supply of warm, pure air by gravity flow.

In the floor of the closet between the rooms on each side of the lower corridor there is a rotating register connecting with the cold air rooms below.

In the basement of one of the corridor extensions there is also a supplementary means of supplying air by a fan driven by an electric motor, and 800 square feet of indirect cast iron radiation, divided into sections of 100, 140 and 160 square feet, as in the other cold air rooms.

This part of the apparatus is intended to be used in moderate and calm weather, when the requisite supply of fresh air is not easily obtained by the gravity system without overheating, especially in the spring and fall months.

When in use the windows leading from outside directly into the grav-



PLAN OF SECOND STORY IN EIGHT-ROOM SCHOOL HOUSE, SHOWING LOCATION OF FLUES

ity cold air rooms are to be closed, and the sliding damper at the entrance of the galvanized iron ducts into the gravity cold air rooms opened, the windows in the cold air corridor extension basement opened and the fan run by the motor, the air either passing through the heated radiators, or, by means of a specially designed damper, going to the fan without passing the radiators. This damper can be used as a mixing damper to regulate the heat and allow more or less warm or cold air to pass the fan as may be desired.

A four-inch diameter metallic thermometer, placed in the side of the galvanized iron duct leading to the air rooms at the bottom of the warm air flues, which go to the schoolrooms, will enable the janitor to regulate the temperature of the air sent from the fan. Should it be desired to use the fan when the air is colder than the fan radiation can properly warm, a portion of the radiation in the other cold air rooms can be used to good advantage.

By the use of this combination system forty cubic feet of air per minute can be supplied for each pupil under all conditions of temperature.

While it may add somewhat to the first cost of the building, the effective work will more than make up for the extra first cost.

If electric power is not available, the fan may be run by an engine having a large diameter, low pressure cylinder. This, however, will require a change in the piping and setting up of this part of the apparatus, and a small boiler of sufficient size to run the engine and also furnish (at a reduced pressure) steam for the vent flue heaters when the larger boilers are not in use.

In addition to the two horizontal tubular, a cast iron sectional boiler

is supplied for heating the vent flues when the electric motor is used or when the larger boilers are not fired up.

The warm air flues and the vent flues are of the same size and location, and similarly provided with dampers and heat, as previously described for other school buildings.

Sections are given showing cold air rooms, indirect radiators, mixing dampers and fan.

The Use of Gas Heaters in Connection With Fan Systems

The advantages of the indirect or fan system for the distribution of heat unit in shops and foundries has led to many improvements in the methods for accomplishing the desired result, the aim being to make such a system as absolutely dependable and as automatic as possible. If has been found that installations of this character can be made wholly successful in operation, and as the costs of installation and operation have been brought within reasonable figures, these questions can usually be eliminated when a heating plant is being considered.

The most direct problem is the source of heat and how to transfer that heat from the combustible to the air supply to the building. There are in use to-day mostly plants in which radiation from coils of pipe filled with steam are depended upon to raise the temperature of the air passing through them. Most of these installations have steam power plants in connection with the heating systems and, therefore, no inconvenience is experienced in providing either live or exhaust steam to the steam coils.

Recent progress has instituted a demand for a heater so arranged as to accommodate gaseous fuel and provide for the transfer of the heat of combustion directly to the air. Gas heaters have been brought out to meet this demand, which comes not only from the natural gas regions but from points where it has been found that as good efficiency can be obtained where coal is used in a gas producer and the gas obtained thereby used under a heater of the type described, as by burning the coal under a boiler and supplying steam to radiators of an indirect system.

With particular reference to natural gas regions it may be stated that a report on a series of tests made by Mr. Jay M. Whitman before the American Society of Mechanical Engineers, in December, 1905, shows that the efficiency of a gas-fired boiler is seldom in excess of 65% to 70%. This low efficiency was found to be due to the excessive amount of air which is used in the process of combustion. Following this reasoning, however, it would seem that the efficiency of the direct heat furnace would be even lower, as it would be necessary to maintain a much lower furnace temperature to preclude the possibility of burning out the flues and heater parts.

This is the problem which has presented itself and a solution has been found which brings out the fact that the efficiency of a gas heater can be as high as 90% at its full capacity and that the efficiency is more nearly constant than the efficiency with the boiler plant, when the latter is operated below its rated capacity, in which case it is known that since the stack and radiation losses are practically constant, the efficiency drops rapidly. The opposite of this has been found in the case of a gas-fired heater because the percentage of stack losses decreases at the lower capacities, due to the lower temperature of the products of combustion.

The most interesting part of the apparatus alluded to is the novel design of the burner and scheme of combustion chamber, designed to secure high efficiency with low furnace temperatures. The heater construc-

tion will be understood by referring to the drawings.

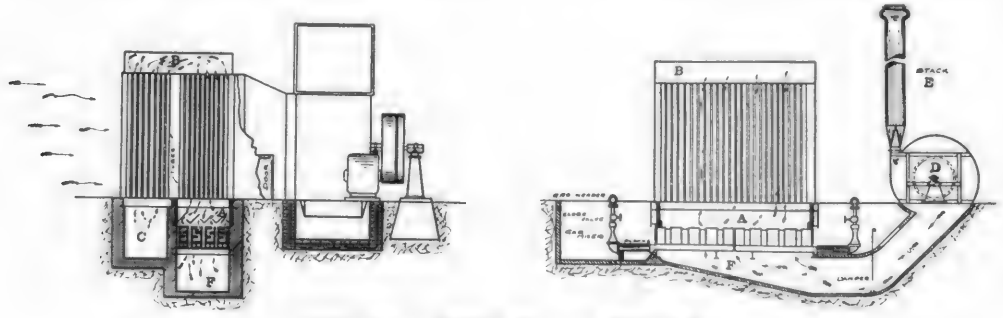
The apparatus consists in general of a bank of vertical 4-inch boiler tubes expanded at the top and bottom into wrought iron boiler plates. The space beneath the tubes is below the floor line and is divided into two compartments.

The first compartment A comprises the furnace proper, where the gas is burned under special conditions described later. The other portion underneath the tubes, marked C, is an exhaust chamber for the burnt gases.

Above the tubes is located a single chamber B, which is provided with a removable sectional cover to allow for cleaning and the inspection of the tubes.

The path of the hot gases is thus upward from the chamber A to chamber B, hence downward to chamber C through the tubes, as shown in the drawings. At B is an exhaust fan which handles the waste gases.

The bank of tubes is enclosed at the top, bottom and two sides and the current of air for heating purposes is drawn through by the motor-driven steel-plate exhauster at E. From this fan the air, heated to a temperature of about 170°, is distributed through galvanized iron ducts in the usual manner employed with the indirect system.



SECTIONAL VIEWS OF GAS HEATER

BURNER

Very briefly stated the success of the burner depends largely, first, upon burning the gas in a combustion chamber lined with fire-brick kept at a high temperature, and a very small excess of air, and, second, diluting the small volume of hot gases at high temperature with a large volume of the recirculated products of combustion at the relatively low temperature of about 400°, giving a resultant temperature not to exceed 1200°.

The combustion chambers are fed by 16 gas mixers and are four in number, being nine inches wide, running parallel with the length of the furnace. The fire-brick becoming incandescent provides for the completeness of the combustion, before it leaves this chamber and passes upwardly into the flues of the heater.

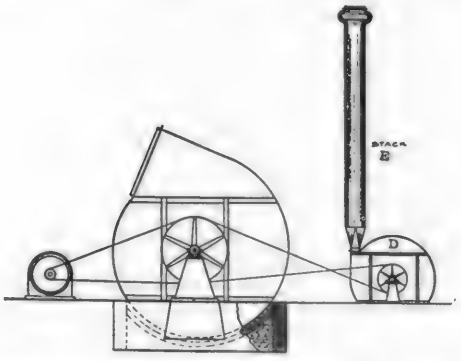
The cooler products of combustion are drawn into an exhaust fan and are partly discharged into a small vertical stack, but by far the greater portion of them are returned to the chamber F under the burners. This gas mixes with the products of combustion above the burners, aided by cast-iron baffle plates. The dilution of the gases with the cooler flue gas does not disturb the combustion, as this is complete when this dilution occurs.

The gas mixers supplying the burners are also of special construction, being designed to work with pressures from 10 to 20 pounds. Due to the type of burner in use, the mixers must supply fuel with a quantity of air slightly in excess of that required for perfect combustion, while ordinarily burners use a mixture of gas and air containing gas in excess, so that combustion is made complete by the introduction of additional air into the furnace to supply the deficiency.

The difficulties experienced in attempting to burn a mixture containing the full quantity of air are due to the tendency of the flame to strike back through the burner openings, unless the velocity of the gas be sufficiently high. Associated with this is the fact that unless the combustion takes place at a very high temperature the flame is very easily put out. For these reasons the gas "injector" shown in the drawings was designed, being a compound nozzle which supplies a relatively large amount of air to the burner.

A test was made upon the burner in which the fuel was supplied at a pressure of slightly over ½-inch water pressure, and it was found that when the flames just disappeared at the top of the fire-brick chamber (regulated by adjusting the air ports) the combustion was practically perfect.

Analysis of the flue gas showed from 1 to 2% of oxygen, one analysis as low as ½ of 1%. While theoretically the temperature of such combustion would be 5,000 or 6,000° F., but little more than one-half of this was attained in the combustion chamber, due to the fact that the thin fire-brick walls are surrounded on the

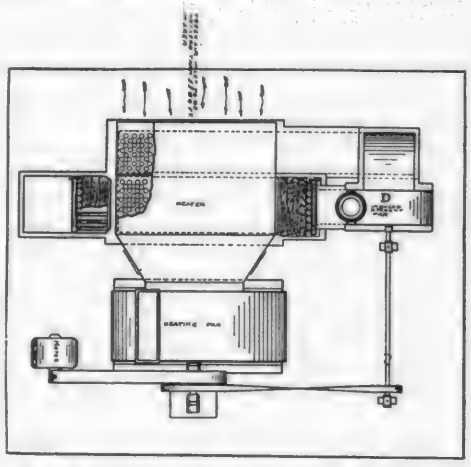


SIDE ELEVATION OF HEATING FAN, MOTOR AND INDUCED DRAFT FAN

outside by the cooler flue gases, which had been recirculated by the fan at high velocity. All portions of the cast-iron burner are outside of the combustion chamber, save the top, which is amply protected by fire-brick. The fire-brick lining is of the best grade and capable of withstanding 4,000° F.

EFFICIENCY OF THE BURNER

Though a large volume of the flue gases is circulated to maintain a low temperature and in that way secure an efficient transfer of heat from the products of combustion to the air supplied to the building, it will be seen that the volume of gases discharged as useless equals that supplied as air to insure perfect com-



VIEW SHOWING PLAN OF GAS HEATER

bustion. Due to the fact that the furnace is of the internally-fired type, radiation is utilized and actual efficiency would closely approximate the theoretical as calculated from the furnace temperatures. Since 9 cubic feet of air and one cubic foot of gas are required in the production of 1,000 B. T. U., there will be lost nearly 60 B. T. U. with the temperature of the waste gases at 400°. These results correspond to an efficiency of 94%.

USE OF GAS FURNACE WITH PRODUCER GAS

The average producers on the market insure an efficiency of from 65% to 70% efficiency when using soft coal and this allows a combined efficiency of gas heater and producer of about 60%, while the average boiler giving a maximum efficiency of 65% would afford only 50% to 55% under the variable conditions of a heating plant. This would seem to leave a wide margin in favor of using a gas-fired furnace for heating in plants where steam is not used as a

motive power and shows that the gas heater with producer gas may be operated quite as economically as a steam-heating system.

A TYPICAL INSTALLATION

An interesting example of an installation of one of the Buffalo Forge Company's gas heaters is in the M. K. & T. Roundhouse at Parsons, Kansas, which is situated in the natural gas belt and hence uses the natural gas to fire the heater. Gas is supplied at a pressure of 40 pounds.

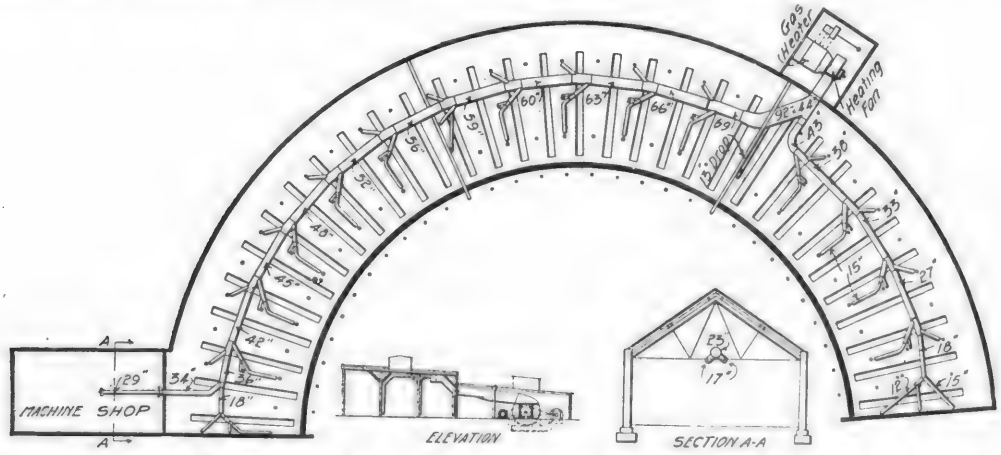
Here the schemes considered were to use steam coil supplied from a low-pressure, gas-fired boiler or to use the gas furnace. The latter was adopted as being the most efficient and practical. The gas heater plant could also be placed for considerably less money.

OPERATING COST

In the Parson's roundhouse, which contains 32 stalls, and also a machine shop, it was computed that about 8,000,000 B. T. U. per hour would be required for heating to 65° in zero weather. It was shown that with a steam plant an initial fuel equivalent of 12,000,000 B. T. U. would have had to be furnished while with the above heater 9,000,000 B. T. U. However, under average conditions about one-half of the above heating values would be required, which would allow an average saving of 1,500,000 B. T. U. per hour and a maximum economy of 3,000,000 B. T. U. per hour. The average is equivalent to about 1,500 cubic feet of gas per hour, which at 12 cents a thousand, means a saving of 18 cents per hour, or $3.60 per twenty-four-hour day. In addition must be counted the saving in labor and attention required. An estimate of $400 yearly is made, which is 8% on the cost of the equipment.

VIEW OF HEATER, FAN AND MAIN DUCT IN M. K. & T. ROUNDHOUSE, PARSONS, KAN.

GAS INJECTORS FOR USE WITH GAS HEATERS



INSTALLATION OF HEATING SYSTEM IN M. K. & T. ROUNDHOUSE AT PARSONS, KAN., EQUIPPED WITH BUFFALO FORGE COMPANY'S GAS HEATERS

Principles of Electric Heating

By Charles L. Hubbard

Unless electricity can be produced at a very low cost, it is not practicable for heating residences or large buildings.

The electric heater, however, has quite a wide field of application in heating small offices, bath rooms, dens, etc., and is a convenient method of warming isolated rooms on cold mornings in late spring and early fall, when the regular heating apparatus of the building is not in operation. It has the advantage of being instantly available; and the amount of heat can be regulated at will. They are clean, do not vitiate the air, and are easily moved from place to place as required.

Heat is obtained from the electric current by placing a resistance in its path, and all electric heaters are constructed upon this principle.

There are various forms of heaters in use, some consisting of a series of loops or coils of iron wire so arranged that a variable number can be thrown into the circuit, as more or less heat is required.

In other cases the heating material is embedded in enamel or fireclay or other substance of a similar nature, which is a non-conductor of electricity but a good conductor of heat. The resistance is usually so proportioned that the temperature of each coil or section is constant under the action of the current supplied; regulation being secured by varying the number of coils in use.

The formula for the calculation of electric heaters is $H = I^2\ Rt. \times .24$, in which

H = heat, in calories.
I = current, in amperes.
R = resistance, in ohms.
t = time, in seconds.

Calories (H) may be changed to thermal units (B. T. U.) by dividing by 252.

Since the resistance of metals increases with the temperature, a thin wire heated by a current passing through it will resist more and more, and grow hotter until the loss of heat by conduction and radiation equals that supplied by the current.

In a short wire, fusion will begin before sufficient heat can be given off for commercial purposes, so that in electric heaters it is necessary to use either long lengths of thin wire, or carbon which resists fusion. In the majority of heaters, coils of thin wire are used, separately embedded in some substance of poor electrical, but good thermal conductivity, as already stated.

Examples—What resistance must an electric heater have to give off 6000 B. T. U. per hour, with a current of 20 amperes. We know that 1 B. T. U. = 252 calories, so in the present case $6000 \times 252 = 1{,}512{,}000$ calories, must be provided.

Substituting the known value in the formula, we have,

$$1{,}512{,}000 = 20^2 \times R \times 3600 \times .24,$$

from which

$$R = \frac{1{,}512{,}000}{345{,}600} = 4.37 \text{ ohms.}$$

A heater having a resistance of 3 ohms is to supply 3,000 B. T. U. per hour. What current will be required?

$3000 \times 252 = 756{,}000$ calories. Substituting the known values in the formula, and solving for 1, we have $756{,}000 = 1^2 \times 3 \times 3{,}600 \times .24$, from which $1 = \sqrt{291.6} = 17 \times$ amperes.

The method of connecting electric heaters with the mains is practically the same as for lights which require the same current. The principle of electric heating is sometimes compared with a steam system in which the radiators have two pipe connections, and the condensation is returned to the boiler by a pump.

In the electric system the boiler pressure is represented by the electromotive force, and the pump is replaced by a generator.

The commercial unit for electricity is the *watt-hour*.

We have learned in text-books on

electricity that 1 watt = 1 joule per second.

1 joule = .24 of a calorie.

1 calorie = 1—252 of a B. T. U.

From this 1 watt-hour =

$$\frac{60 \times 60 \times .24}{252} = 3.42 \text{ B. T. U.}$$

Electricity is usually sold on the basis of 1,000 watt-hours, called Kilowatt-hour, which is equivalent to 3,420 B. T. U.

From this it is evident that the B. T. U. required per hour for warming any given room, divided by 3,420, will give the Kilowatt-hours necessary for supplying the required amount of heat.

The expense of heating in this manner must always be great unless the electricity can be supplied at an exceedingly low cost. Based on present practice, the average transformation into electricity does not account for more than 5 or 6 per cent. of the energy in the fuel which is burned in the furnace.

In steam and hot-water heating, the average amount utilized will probably be about 60 per cent., from which the expense of electric heating is found to be from 10 to 12 times great er than by these methods. This may be shown in another way by a practical example.

Let us assume that by the use of good coal, well designed boilers and condensing engines, we are able to deliver 1 H. P. for each 2 1-2 pounds of coal burned per hour. Let us also assume the combined efficiency of the dynamo and circuit to be 85 per cent. Then each H. P. delivered by the engine produces .85 electrical H. P. at the heaters, which is equivalent to

$$\frac{.85 \times 33{,}000 \times 60}{778} = 2{,}163 \text{ B. T. U.}$$

per hour.

Since it requires 2 1-2 pounds of coal to produce 1 H. P., it follows that the heat given out at the radiator per pound of coal burned in the furnace will be $2{,}163 \div 2\frac{1}{2} = 865$ B. T. U.

A well-designed steam or hot-water heating system utilizes about 9,000 B. T. U. per pound of coal. Therefore, the efficiency of the electric system is to that of the steam system as 865 is to 9,000 or 1 to 10.8.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Under date of October 30th, the proposed alterations and amendments to the constitution and by-laws of the Society permitting the organization of local chapters was submitted to the members by mail ballot. The proposed article is numbered Article IX, and is as follows:

Local Chapters of the Society may be formed upon application of ten members in any State or Territory or in any political division of any other Country, if the organization of such local chapter will, in the judgment of the Board of Governors of this Society, advance the Society's interests.

Upon the recommendation of the Board of Governors, a charter may be granted by the Society to form such local chapter, which shall be operated and conducted under the control and at the pleasure of this Society; such local chapter shall be governed by the Constitution and By-Laws of this Society in so far as they shall not conflict with the laws of such State, Territory or other Country, and by such other local By-Laws as may be adopted by the local chapter and approved by the Board of Governors of this Society before becoming operative.

The membership of such chapter shall comprise only members of the different grades in good standing in this Society; any member of any local chapter who shall cease to be a member of this Society shall thereby forfeit all right to membership in such local chapter.

Every such local chapter when formed, shall be chartered in the name of the State, section of State, County or City, in which the same shall be located.

As announced last month, the thirteenth annual meeting of the Society will be held in New York, Tuesday, Wednesday and Thursday, January 22, 23 and 24, 1907. The sessions will be held in the new Engineering Building, on West 42nd Street, near Fifth Avenue, if ready. In case of delay in finishing the building, the sessions will be held at the old quarters of the American Society of Mechanical Engineers, 12 West 31st Street.

It is announced that the three committees engaged in securing data on standard sizes of steam and return mains, hot water heating and steam heating, are desirous of securing at an early date answers to their questions to enable them to finish their reports

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Banquet of the Newark Local Association

The Master Steam and Hot Water Fitters' Association of Newark and vicinity will hold its second annual banquet, December 13, at Doelger's banquet hall, Newark, N. J. Those who attended last year's banquet will recall the success with which it was carried out and we are assured that this year's reunion will be accompanied by the same generous hospitality. Doelger's banquet hall is at 350 Morris Avenue, between Springfield and 15th Avenues. The banquet will be served at 6 o'clock. The committee in charge include Thomas B. Cryer, E. R. Soleau and Sol. Berla. Tickets, which are $5.00 each, have been sent out with the request that remittances be made to Mr. T. B. Cryer, 249 High Street, Newark, N. J. not later than December 5th.

British Institution of Heating and Ventilating Engineers.

The British Institution of Heating and Ventilating Engineers held its autumn meeting October 9th last, at the headquarters of the Institution of Mechanical Engineers, in London, England. President W. N. Haden was elected to serve another term, beginning in January. Three candidates for membership were admitted and four for associate membership. Mr. J. Roger Preston, Lancaster, who submitted a paper on "Air Analysis as an Aid to the Ventilating Engineer," (published in our October issue), was one of the four candidates for associate membership. Besides Mr. Preston's paper, one on the labor problem by Mr. F. S. Russell, of London, was read. At the winter meeting, to be held in London, February 19, 1907, the members were informed that important papers on the standardization of pipes, by Mr. L. F. Pearson, and on the ventilation of the Houses of Parliament, by Mr. Walter Yates, would be read. Mr. C. Knuth, of Budapest, will present a paper on the ventilation of the Stock Exchange of that city, probably at the summer meeting.

New England Foundrymen's Association

The calendar for 1906–7 has been received and includes a program of the meetings to be held during the winter. Among those who will address the Association are: Thomas D. West, of Sharpsville, Pa., (December 12) on "Cause, Cost and Remedy for Carelessness;" Herberr E. Field, of Pittsburg, Pa., (Decembet 12), on "Foundry Education;" George Schuhman, of Reading, Pa., (February 13), on "Iron and Steel;" Arthur Simonson, of Philadelphia, Pa., (February 13), on "Moulding Sands;" Prof. Edward F. Miller, of Massachusetts Institute of Technology, (March 13), subject announced later; Edwin A. Moore, President American Coke and Gas Consumption Company, Camden, N. J., (April 10), "By-Products, Coke, etc.;" Roy U. Conger, New York, (May 8), on "Scientific Salesmanship."

Society of Naval Architects and Marine Engineers

The fourteenth general meeting of the Society will be held at 12 West 31st Street, New York, Thursday and Friday, November 22 and 23, 1906. A banquet has been arranged at Delmonico's on the evening of the 23d.

Franklin Institute, Philadelphia.

J. V. Standford, of the mechanical engineering department of the University of Pennsylvania, addressed a section of meeting of the Institute, November 1st last, on "The Direct Leakage of Steam Through Steam Valves."

American Society of Mechanical Engineers

The annual meeting of the American Society of Mechanical Engineers will be held in the assembly rooms of the New York Edison Company, 44 West 27th street, New York, Tuesday, Wednesday, Thursday and Friday, December 4-7.

Following is a list of the papers that will be read: "The Art of Cutting Metals," "The Evolution of Gas Power," "Producer Gas Power Plant," "Steam Turbine Characteristics," "A High Duty Air Compressor," "Design of an Improved Boiler Setting," "Steam Plant of the White Motor Car," "Saw-tooth Roof Construction," "Furroinclave Roof Construction," "Saw-tooth Roofs for Factories," "Weights and Measures," "Mechanical Engineering Index," "Ventilation of Boston Subway," "Flow of Fluids in Venturi Tubes," "Tests of an Elevator Plant," "Test of a Rotary Pump," "Improved Transmission Dynamometer" and "A Plan to Provide Skilled Workmen."

American Brass Founders' Association is the title of a new organization of brass manufacturers. Charles J. Caley, general superintendent of the Russel & Erwin Mfg. Company, New Britian, Conn., has been appointed chairman, and Dr. Richard Moldenke, secretary of the committee appointed at Cleveland.

National Founder's Association held its tenth annual convention in New York, November 14 and 15.

Ohio Society of Mechanical Steam and Electrical Engineers held its annual meeting November 16 and 17, at Akron, Ohio.

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Manuscripts submitted for publication must in every case be accompanied by postage; otherwise they will not be returned.

THE presentation in this issue of the actual records of the temperature of the atmosphere in New York City during the years 1887-1898 will, we feel sure, prove of interest and permanent value to all engaged in heating work in localities where the climatic conditions correspond closely to those of the metropolis. The records are those reported by the New York Herald for the years indicated, and the thermometer from which they were taken was attached to the outside of the Herald Building. The reports differ in this respect from the other monthly reports we are publishing in that the latter are made by the United States Weather Bureau from the tops of lofty buildings where the weather is unlikely to be affected by the conditions to be found at a lower level.

It would seem that for the use of the heating engineer the records obtained closer to the street level are more useful, as most buildings are protected more or less from the free sweep of the wind as it occurs far above the ordinary roof line.

In proof of this, it is noteworthy that the temperatures reported near the street level are, as a rule, a few degrees higher than those observed by the local weather bureau and in several instances during zero weather, the official records run from 6 to 8 degrees below zero when thermometers, at a lower altitude, hovered around the zero mark.

WE have been fortunate enough to secure a unique diary, compiled in a most painstaking manner, which contains not only clippings taken daily from the Herald during the years 1887-1898 and temperature observations made every three hours each day during that entire period, but includes also clippings and comments on the general weather conditions, covering reports of all important storms or other atmospheric disturbances during that time. These reports, made up in book form, are on file at this office where anyone interested is welcome to examine them at any time.

ACTION taken at the recent annual meeting of the Central Supply Association at Cleveland, Ohio, is of special interest in connection with the conferences that have been going on between committees representing the Boiler and Radiator Manufacturers' Association and the National Association of Master Steam and Hot Water Fitters. The action referred to was in the form of the following resolution which was adopted unanimously: "Resolved, That no member of this Association (Central Supply Association) shall accept any order for material with the following or

any other similar conditions: 'This order is given on condition that the firm supplying the goods will pay for replacing any part that, when tested, is found defective. The measure of damage shall be the price of the defective part or material.'"

The condition here referred to is one that has been adopted by a number of the local associations of the National Master Fitters' Association. An amendment to the condition, suggested by one manufacturer, is that the words "in manufacture" be added to the words "found defective."

A NEW ruling of the Post Office Department regarding the printing of blank coupons or other forms in advertisements, which coupons are designed to be torn out by the reader and returned to the advertiser, will be of interest to all who use this method of advertising. The ruling is that the printing of such coupons or, it may be, of the advertisement itself, if the same is designed to be detached and returned, makes of such coupon or advertisement so much writing paper or merchandise which, therefore, is not admissible to the mails at the pound rate accorded second-class matter. So many interests will be affected by this ruling that a time limit until March 1, 1907, is granted to enable advertisers to adjust their business to this new order of things.

ADVANCE reports of the forthcoming meeting of the various engineering societies contain programmes of more than usual interest to heating and ventilating engineers. At the annual meeting of the American Society of Mechanical Engineers in New York, December 4-7, the programme includes a report of the committee on Standard Proportions for Machine Screws. Among the other subjects, on which papers will be read, are: "Steam Turbine Characteristics," by Hans Holzwarth;" Design of an Improved Boiler Setting," by A. Bennet; "Weights and Measures," by Henry R. Towne; "Ventilation of Boston Subway," by A. J. Carson; and "Test of a Rotary Pump," by Prof. W. B. Gregory. Some features of ventilation of the Boston Subway were illustrated in the June, 1906, issue of this magazine, and the paper upon this subject includes the illustrations which appeared in that issue.

Among the papers read at the Ohio Society of Mechanical, Electrical and Steam Engineers, held at Akron, Ohio, November 16-17, were the following: "First Principles of Thermal Storage," by J. E. Bell; "Manufacturing Costs," by R. H. Probert; "Some Experiments with Gasoline," by E. W. Roberts, and "Heavy Duty Engine Service," by A. L. Strickland.

IN connection with the use of oil for fuel, a project is being engineered in Kansas involving the building of a network of pipe lines throughout the State to carry crude oil from Southern Kansas and the Indian Territory to the various towns to be used as fuel for electric lighting and heating purposes. The plans do not include the ownership of the plants themselves which may be operated by municipalities or by individuals. Fuel contracts are all that will be sought by the company.

The Ventilation of Tunnels*

By Charles S. Churchill

In 1904 the writer presented to the International Engineering Congress a paper on the "Ventilation of Tunnels."† Since that date improvements have been made in some of the tunnels and subways referred to, which are worthy of note, and the writer has obtained certain additional data as to the condition of the air in some subways and tunnels in Europe, which are valuable for comparison in determining good practice.

GALLITZIN TUNNEL

The ventilating plant at Gallitzin Tunnel, west of Altoona, on the main line of the Pennsylvania Railroad, was referred to in that discussion as being of the same type as that of the Elkhorn Tunnel, on the Norfolk and Western Railway, and as being practically completed at the date of the discussion.

This ventilated tunnel is 3,600 ft. long, and is built for a single track, being 17 ft. wide and 20 ft. 5 in. high, and is lined with concrete. Its sectional area is 324 sq. ft, and the cubical contents of the whole tunnel are 1,166,400 cu. ft. There is an ascending grade of 0.5 per cent. from the east end through the tunnel, but the east approach is on a heavier grade, so that west-bound freight trains generally have a pusher engine at the rear of each in passing through the tunnel.

The accompanying illustration shows the general arrangement of the ventilating plant and all important details, its location being at the east or lower end of the tunnel.

With fans making 145 rev. per min. the observed flow of fresh air through this tunnel from east to west is at a velocity of 1,780 lin. ft. per min., equivalent to 576,000 cu. ft. per min. As usually operated, these fans make 130 rev. per min., while freight trains are in the tunnel, and the velocity of the air in the tunnel is 1,550 fet. per min., which results in 502,-000 cu. ft. of fresh air being delivered through the tunnel each minute. With the fans running at this speed, the tunnel is cleared directly after the exit of a west-bound train. Excepting when freight trains are in the tunnel, the fans run at from 40 to 60 rev. per min.

There are, as shown, two 8 by 16-ft. fans, one on each side of the track, each operated by a direct-coupled engine of about 200 h. p., the total rated horse power of the plant being 400. This ventilating device was put into regular operation in April, 1905.

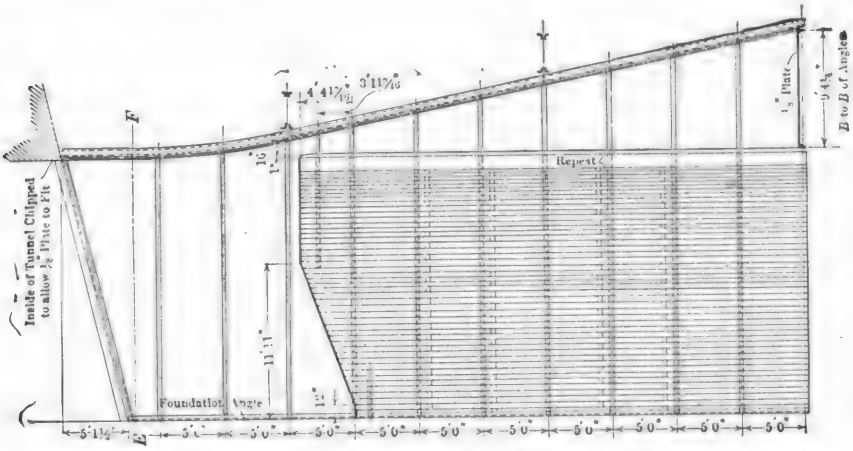
PARK AVENUE TUNNEL, NEW YORK CITY

The work of providing for electrical operation, which was undertaken partly for the purpose of improving the ventilation, is rapidly progressing, under plans fully described, with official reasons therefor. The reasons given are, briefly: Improvement of ventilation, greater safety in operation, and increased capacity.

SIMPLON TUNNEL

This tunnel, which is 12.33 miles long, and is constructed for a single track, with one passing siding at the center, was completed early in 1906, and was formally opened on May 19, 1906.

When the writer visited this tunnel, in the summer of 1905, a steel sliding door at each portal was arranged so as to be raised and lowered by electric power. The plan at that time was

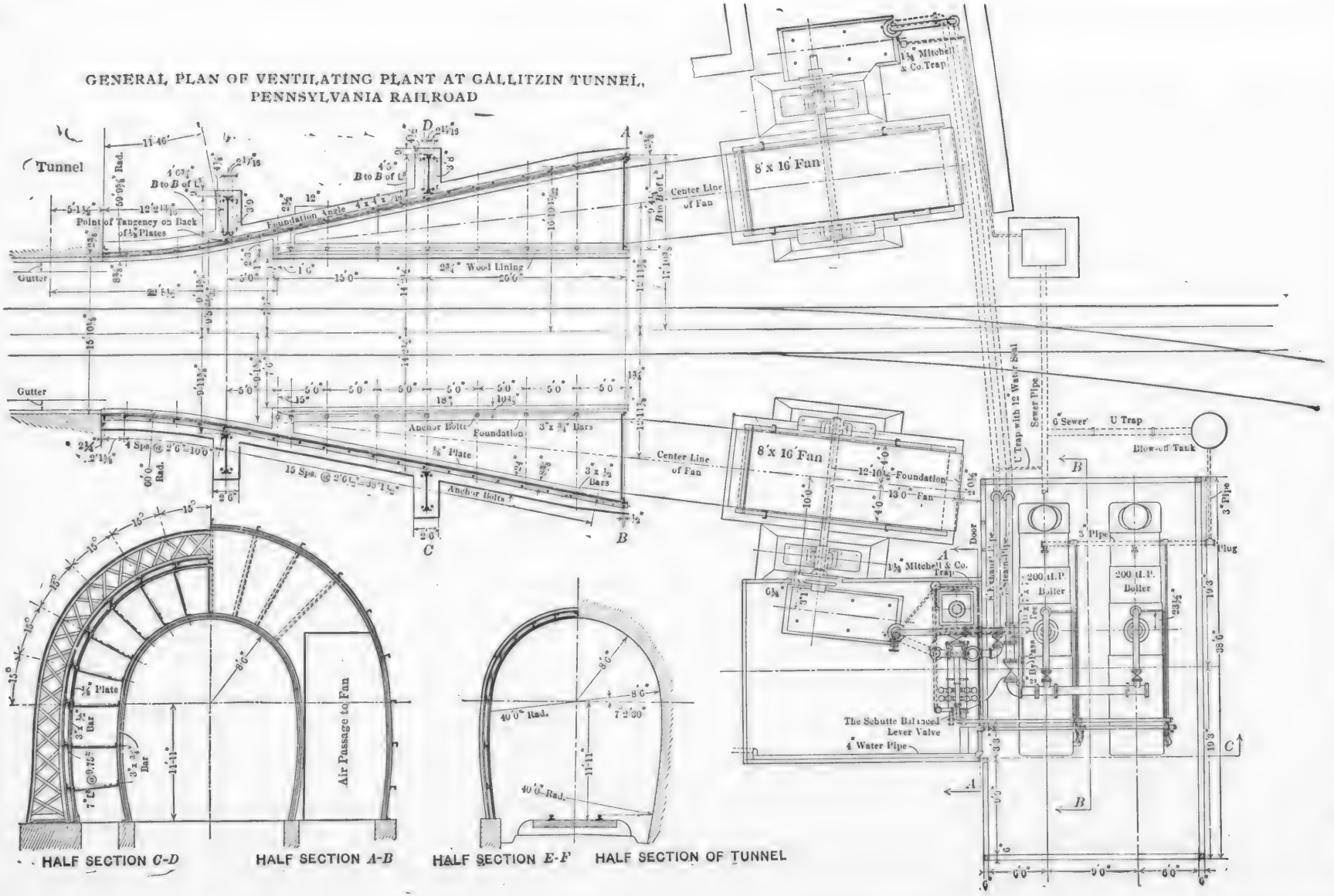


LONGITUDINAL SECTION, ⅛ INCH PLATES REMOVED—GALLITZIN TUNNEL

*From a paper read September 19, 1906, before the American Society of Civil Engineers and appearing in Vol. xxxii, page 440, of the Proceedings.

†Published, with articles by other writers on this subject, in Transactions, Am. Soc. C. E., Vol. liv, Part C, pp. 523-578.

GENERAL PLAN OF VENTILATING PLANT AT GALLITZIN TUNNEL, PENNSYLVANIA RAILROAD



to lower the steel door after the entrance of a train and to force fresh air from the fans at that end of the tunnel into and through the tunnel with considerable pressure.

The adoption of electricity as the power for handling trains through this tunnel has greatly simplified the problem of ventilation.

THE ST. GOTHARD RAILWAY TUNNEL

This steam railroad tunnel is 9.3 miles long, is located on light grades, and is double-tracked. It has a large section, the area being 603 sq. ft., or approximately 3.2 times the area of two trains occupying the tunnel section. The cars of trains while in the tunnel are lighted by gas.

This tunnel is ventilated by a Saccardo plant, at Goeschenen, at the north end of the tunnel. It consists of two large fans operated by water power. Ventilation is secured by reducing the area of the tunnel section by about 38 per cent. near its northern end.

For comparative purposes, a sample of air was taken by the writer from a car of a north-bound train, running 30 miles per hr., at a point about 3 miles from the south end. The temperature was 82° fahr., and the air contained 10.19 parts of carbonic acid gas (CO_2) per 10,000 volumes. The measured quantity of fresh air which the writer found to be passing into the north end of the tunnel from the ventilating plant was 413,000 cu. ft. per min. at a velocity of 686 ft. per min.

Special attention is called to the large area of the tunnel section relatively to the cars used, and the consequent small velocity and volume of fresh air used in ventilation. The other favorable condition in this tunnel is the light grade throughout its length, so that the coal consumption of locomotives while in the tunnel is kept low. At the measured velocity of the ventilating air current, a period of 1 hr. and 12 min. is required to change the air in this tunnel.

THE BERLIN ELEVATED AND ELECTRIC RAILWAY

This electric railroad is largely above ground, but there are short sections of subway, having a rectangular section of about 231 sq. ft., in which single span there are two tracks. The stations are roomy, and each is provided with two large stairways leading directly to the surface, thus insuring fair ventilation. The air in these short subway sections was noted by the writer as being good.

METROPOLITAN RAILWAY, PARIS

The Metropolitan Underground Railway, of Paris, is a double-tracked arched tunnel, nicely lined, and built as close to the surface of the streets as practicable. It is electrically operated. The stations are comparatively close together, averaging less than 1,700 ft. apart. The two tracks are in one span, the area of the tunnel section being 315 sq. ft. This section is greatly enlarged at each station, thus providing in one span ample room for platforms. The area of the tunnel is approximately twice that of the two trains occupying the tunnel section.

This railway is specially notable for the large tunnel section, roomy stations at short distances apart, and the provision of two large stairways at each station, giving good direct outlets for ventilation. Two short portions of two lines of this road were examined by the writer. A sample of air taken at 7.40 o'clock on a bright morning, from a Metropolitan Railway car, between Palais Royal and Alma Stations (between which there were five stops at intermediate stations), temperature 70° fahr., contained 2.94 parts carbonic acid gas per 10,000 volumes of air, the outside air at that time containing 1.76 parts.

THE MERSEY TUNNEL, LIVERPOOL

This tunnel is 2 miles long, has a section of about 425 sq. ft., and is provided with two tracks. It is now electrically operated, and is well ventilated by large fans. The air in this tunnel is now good. A sample taken by the writer from a car in this tunnel, July 24, 1905, contained 4.70 parts of carbonic acid gas per 10,000 volumes.

THE DISTRICT RAILWAY, LONDON

The District Railway is a double-tracked subway, with its grade level generally as close as practicable to the streets above it, and with frequent openings to the surface, in addition to having stations approximately ½ mile apart. It is operated by steam, but is is being gradually electrified, primarily to secure better ventilation.

For comparative purposes, the writer quotes a test, made in 1902 for the London County Council, which showed that the air in a car contained 15.1 parts of carbonic acid gas per 10,000 volumes. A sample of air taken from a District Railway car by the writer, between Mansion House and Temple Stations, on a fair day, June 27, 1905, at 4.25 P. M., temperature 76°, contained 11.27 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing 3.55 parts.

METROPOLITAN RAILWAY, LONDON

The Metropolitan Railway is similar to the District Railway in construction and operation, and is also being gradually electrified, for the same reasons.

A test made in 1902 for the London County Council showed that the air in a car on this road contained 28.8 parts of carbonic acid gas per 10,000 volumes. A sample of air taken from a Metropolitan Railway car by the writer, between Gower Street and Portland Road sta-

tions, on a very clear day, July 24, 1905, at 12.40 P. M., temperature 74°, contained 14.07 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing only 1.75 parts.

CITY AND SOUTH LONDON RAILWAYS

This electrically operated line extends from Angel to Clapham Road, about 6 miles, with thirteen stations on the entire line, the average distance apart being ½ mile. It consists of two single-track tubes, the inside diameter of each being 10 ft. 6 in. They are deep below the surface of the ground. As these tubes are small, the clearance around the trains is very narrow. The tubes are connected by small passages at the stations and by cross-overs near a few of them. The area of each tube is 86 sq. ft., the area of both tubes being, therefore, 172 sq. ft.; and one tunnel section equals about 1.4 times that of a train. The travel on this line is not as heavy as on some others, notably the Central London Railway. It is not ventilated artificially, and the air is not as good as in other tubes of the electric railroads in London. The only natural ventilation is through a stairway and generally three lifts at each station. The stairway has a minimum opening of from 35 to 40 sq. ft. One lift contains about 2,500 cu. ft., and has a capacity of about fifty persons. During ordinary light traffic only one of these lifts is required per train.

The draft produced in the tunnel by an approaching train lasts only 1 min., and amounts to only about 17 000 cu. ft. The draft that follows a train lasts about ½ min., and amounts to only about 8,000 cu. ft. At the stairway of Borough Station, at the time of the passage of a train, a down-draft was noted for 1 min., equal to about 7,000 cu. ft. of air, followlowed by an up-draft for ½ min., amounting to above 2,000 cu. ft. of air. In addition to this, each lift removes in its upward passage about 2,500 cu. ft. of air. This quantity per station is clearly insufficient to balance the vitiation of the air by the occupants of a train.

Tests made in 1902 for the London County Council showed that there were 14.2 parts of carbonic acid gas per 10,000 volumes of air in an empty carriage. A sample of air taken from a City and South London car by the writer, between London Bridge and Moorgate Stations, on a fair day. June 27, 1905, at 3.45 P. M., temperature 74° fahr., contained 11.78 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing 3.55 parts.

Another sample, taken on July 24, 1905, from a car of the same road between Elephant and Castle Station and London Bridge Station on a still brighter day, at 9.25 A. M., temperature 69° fahr., contained 8.69 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing only 1.75 parts.

The sample taken in June shows that the car air contained a little more than three times the quantity of carbonic acid gas found in the outside air on that day, while the sample taken on July 24, though lower in this gas, contained nearly five times the quantity found in the fine outside air on that day, and actually seemed to the sense fully as poor in quality as that taken in June.

CENTRAL LONDON RAILWAY

This electrically operated line extends from Shepherds Bush to the Bank, about 6 miles, with thirteen stations in this distance, averaging ½ mile apart. It consists of two single-track tubes, each 11 ft. 6 in., minimum inside diameter, connected by passages at the stations, also by six cross-overs in the entire length. The area of each tube is 100 sq. ft., the area of both tubes being 200 sq. ft. The cubical contents of the entire railroad tubes are equal to about 6⅓ million cu. ft.

The natural ventilation is by a narrow stairway and about three lifts at each station. Mechanical ventilation of the tunnels is secured by a fan at Shepherds Bush Station, which draws in fresh air from the opposite end of the line—that is, Bank Station, and other stations at intermediate points. The fan is 5 ft. wide, 20 ft. in diameter, and makes 145 rev. per min. It is operated by electricity, and is rated at 300 h. p. Its capacity is 100,000 cu. ft. per min. It is operated from 1.00 to 4.00 A. M. (3 hr.), with the outlet doors at all intermediate stations shut, therefore it draws in fresh air from Bank Station. During the operation of the fan, the water-gauge pressure in the tunnel is 4½ in., and the linear velocity of the air in the tunnel is 500 ft. per min. The fan is also operated during each day from 11.00 A. M. to 5.30 P. M., or 4½ hr., all the doors of the passageways at the stations being open. This improves the air in the tunnels for about one-half the length of the line—that is, for the 3 miles nearest to Shepherds Bush Station—it also clears out the cars as they come to this last station.

The result of night pumping, as indicated by an anemometer placed in the tunnels at the Post Office Station (the first one west of Bank Station), shows that each week an average of 123.9 million cu. ft. of fresh air entered during the night pumpings, which is equivalent to 17.7 million cu. ft. per night. As the tunnels contain 6⅓ million cu. ft., they are cleared about 2¾ times each night.

The result of this night ventilation is shown by tests taken on February 15, 1905, at the Marble Arch Station cross-over siding, which is about half way between Shepherds Bush and Bank Sta-

tions. At 9.30 P. M. the air was found to contain 10.3 parts of carbonic acid gas per 10,000 volumes. The fan was started at 1.37 A. M., and at 2.15 A. M. the air at the same point contained only 3.7 parts, which was the same as that in the outside air.

The amount of natural ventilation procurable is shown by some other tests made during the same night. Between 9.30 P. M. and 1.00 A. M. (3½ hr.) the air in the tunnel had cleared slowly from 10.3 parts to 6.0 parts of carbonic acid gas per 10,000 volumes at the latter time. During these tests the temperature of the tunnels was 66½° fahr. Another test, taken on February 2, 1905, with the fans not running, and when the outside air contained 4.4 parts of carbonic acid gas per 10,000 volumes, showed that the tunnel air averaged 7.07 parts of carbonic acid gas, while the air in a full car contained 10.7 parts.

The methods now adopted for ventilating the Central London Railway have been put into force since 1902, and the question of adding to this ventilating system is now being considered.

The first ventilating plant on this road was at Bond Street Station, but it has not been used since the installation of the present ventilating plant at Shepherds Bush.

A long series of tests made in 1902 for the London County Council showed that the air in the cars contained a minimum of 9.60 parts of carbonic acid gas per 10,000 volumes, at a time when the outside air contained 3.30 parts, and a maximum of 14.7 parts of carbonic acid gas per 10.000 volumes, when the outside air contained 3.30 parts.

A sample of the air taken from a Central London Railway car by the writer, between Chancery Lane and Post Office Stations, on a fair day, June 27. 1905, at 1.55 P. M., temperature 76° fahr., contained 5.92 parts of carbonic acid gas per 10.000 volumes, at a time when the outside air contained 3.55 parts.

Another sample taken by the writer on July 24, 1905, from a car on the same road, between Tottenham Court Road and Oxford Circus Stations, on a still brighter day, at 1.00 P. M., temperature 72½° fahr., contained 7.04 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing only 1.75 parts.

GREAT NORTHERN AND CITY RAILWAY, LONDON

The Great Northern and City Railway extends from Moorgate Station to Finsbury Park, a distance of 3.43 miles. It is electrically operated and lighted, and there are six stations. varying from 2,000 to 6 200 ft. apart. Drayton Park Station, which is 4.200 ft. south of the northern terminus, is all in the open for 600 ft., therefore, the main tunnel on this road extends from Drayton Park to Moorgate, a distance of 2.62 miles; the longest distance between stations being from Essex Road to Old Street, 6,200 ft. This line was put into operation in 1904, and is in many respects the best one examined by the writer. It consists of two single-track tubes, each 16 ft. inside diameter, connected by five small cross-passages at each of the station platforms, in addition to some cross-overs. The station platforms are generally 420 ft. long, to accommodate a standard train of seven coaches each 50 ft. long, carrying a total of 430 passengers. The special features of this subway are its large tubes and the large stairways and passageways, as compared with other London subways. Each of these items is claimed by the officials of the road to be a direct benefit in ventilation. The line is expected to handle 27,000,000 passengers per annum. The maximum train service arranged for is a 3-min. spacing, making 3½ miles in 13½ min., including 20 sec. for each of four intermediate stops.

The area of each tube is 190 sq. ft., the area of the two tubes being 380 sq. ft. The area of the tunnel, therefore, is about 1.8 times that of the large cars of the trains therein. The approximate cubical contents from the open end at Drayton Park to the closed end at Moorgate Station is 5½ million cu. ft.

Its natural ventilation is by two stairway passages at each station, the minimum area of each passage being 57 sq. ft., or a total of 114 sq. ft., in addition to that furnished by three lifts at every station, each having a floor area of 130 sq. ft., or cubical contents of about 1,500 cu. ft.

Its artificial ventilation, applied since the line was opened, is obtained by a fan, having a diameter of about 6 ft., located at Pool Street, which is 6,330 ft. from the Moorgate end of the tubes. This fan has a capacity of 1,000,000 cu. ft. of air per hour. and, as operated, forces fresh air through a heading 10 ft. in diameter into the up-tunnel—that is, toward Moorgate Station, in the direction of travel. A large part of this current travels to Moorgate Station crossover and then into the down-tube. The present practice is to operate this fan twice each day, during the busiest periods, from about 8.00 A. M. to 10.00 A. M., and from 5.00 to 8.00 P. M., so that a volume of fresh air practically equal to the cubical contents of the entire subway is forced into it each 24 hr.

As to natural ventilation: Measurements of the currents in the stairways on the arrival and departure of trains show approximately a total of down-currents for each train per station of 20 000 cu. ft., and about the same for up-currents. The total ventilation per

train for each direction, therefore, amounts to about 90,000 cu. ft. On a 5-min. spacing of trains, each filled with 430 persons, the change of air per hour amounts to 1,080,000 cu. ft. in the entire subway, or 18,000 cu. ft. per min. However, as there are constantly four trains in the tubes carrying a maximum of 1,720 people, and as each person requires 30 cu. ft. of air per min., the total requirement is more than 51,000 cu. ft. of fresh air per min., in order to keep the tunnel air of the same quality as the outside air, or about 26,000 cu. ft. per min. in order not to increase the carbonic acid gas by more than twice the quantity in the outside air. These figures show why ventilation has been found necessary during the busy hours to maintain air of the desired purity even in this excellently constructed subway.

On March 5, 1904, before ventilation was established, a test of the air in this subway was made by Dr. Critchley, with the following results: The air in the street was found to contain 4.5 parts of carbonic acid gas per 10,000 volumes, that of a car in the subway was found to contain 90 parts, the temperature being 61½° fahr.

On February 20, 1905, Dr. Southerland found that the air on the platform in the subway at Old Street Station contained 4.48 parts of carbonic acid gas per 10,000 volumes, temperature 54° fahr., while that in a car approaching this station was found to contain 7.22 parts, the temperature being 55½° fahr.

A sample of air taken from a Great Northern and City Railway car, by the writer, between Highbury and Old Street Stations, on a very bright day, July 24, 1905, a little after noon, temperature 68° fahr., contained 2.35 parts of carbonic acid gas per 10,000 volumes, the outside air at that time containing 1.75 parts.

THE RAPID TRANSIT RAILWAY, NEW YORK CITY

The subway sections of this railway are either four-tracked, of rectangular cross-section, or of two double-tracked cross-sections. The former is the one used on the busiest part of the line, below Forty-second street. The stations on this portion averaged about 1,500 ft. apart. The area of this four-tracked cross-section is about 650 sq. ft. The sectional area of the tunnel, therefore, is 1.8 times that of the four trains occupying the subway.

This subway is of steel construction, with concrete, and is built quite close to the surface of the streets. The outlets to the street at the stations consist of from two to a maximum of eight stairways, which, while large enough for the people entering the stations, are not as direct as in some of the European subways, and have not a total outlet area as large in proportion to the tunnel cross-section, or to the number of trains and people in the subway at one time.

The writer predicted in 1904 that mechanical ventilation would be found necessary to secure a positive change of air.

On November 21, 1904, a sample of air was taken from a car in the Rapid Transit Subway, between Forty-second and Twenty-eighth streets, and one between Spring street and Astor Place, and these were found to contain too great a percentage of carbonic acid gas. Again, on December 28, 1905, at 4.00 P. M., the temperature being 60° fahr., a sample of air, taken from a car of the Rapid Transit Railway, between Twenty-third street and Brooklyn Bridge stations, was found to contain 15.58 parts of carbonic acid gas per 10,000 volumes of air.

The various tests of air made by the writer in London and Paris have shown that, except in the deeper subways, the air has as high a temperature as that outside. In the Rapid Transit Subway, during the summer of 1905, a considerably higher temperature of the air was recorded. This is another reason why it will become very urgent to establish a complete system of mechanical ventilation, for the health of the employees and the comfort of the patrons, as in the case of the subway tunnels in Boston, Liverpool and London.

SUBWAY TUNNELS GENERALLY

Among the statements heretofore made are included records of the determination of carbonic acid gas (CO_2) in the London subways as well as in their cars. From these data, also from other similar tests of air reported upon by the London County Council, in subway tunnels when they were not fully ventilated, the air found in subway cars contains about 45 per cent. more carbonic acid gas than the average air found in the subway tunnels and stations. Inasmuch as the patrons and a large number of the employees of a subway tunnel line spend most of their time in the cars, the vital fact to be determined, as to the health and comfort of these individuals, is the amount of carbonic acid gas in the cars themselves. Therefore, tests of air in subway tunnels and stations are simply somewhat indicative of the conditions that will be found in the cars. It may be anticipated that the amount of carbonic acid gas in the cars will be at least 45 per cent. more than in the subway tunnel, and in crowded cars the proportion of carbonic acid gas will be still greater.

The writer, therefore, has confined his investigations everywhere to the vital question, namely, the quantity of carbonic acid gas (CO_2) found in the ordinary cars of tunnels, and the tests by him were taken in cars ranging from

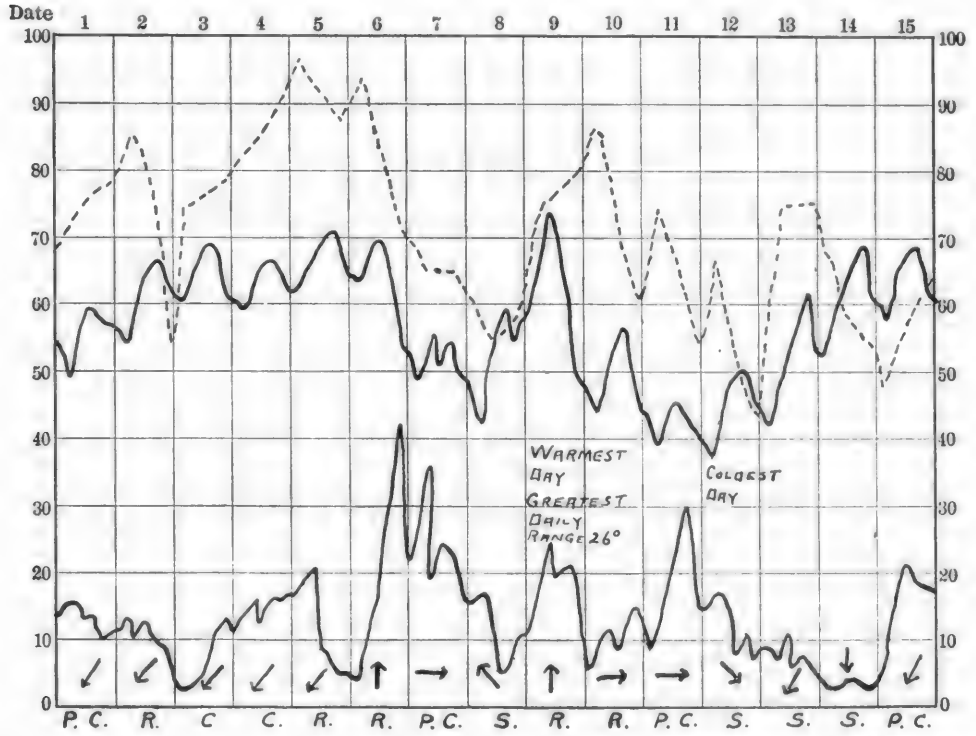
one-fourth to one-half full. Any reports of the amount of carbonic acid gas found in subway tunnels or stations, therefore, should be increased by about 45 per cent. in order to obtain any fair idea of the conditions met by the passengers and employees themselves; so that, if a subway contains as much as 6.5 parts of carbonic acid gas per 10,000 volumes of air, there will probably be found in the cars 8.4 parts or more.

It has further been shown by detailed measurements of natural ventilating currents in the London subway tunnels, from the smallest to those of the largest section, that an insufficient quantity of air is drawn into them to ventilate all parts of them properly. While the portions having light traffic may at times be free from too large a proportion of carbonic acid gas, those parts having heavy traffic will contain an excess. The conditions of traffic in the Rapid Transit Railway of New York, for example, are such as to indicate the presence of much more carbonic acid gas in the cars while traversing the lower portions of the subway tunnel than in the remainder.

Proper ventilation is not secured unless all parts of a subway tunnel receive a sufficient quantity of fresh air to balance properly the vitiation of that in the cars by the occupants thereof, and this result cannot be secured, as has been shown, except by an efficient system of mechanical ventilation that will distribute fresh cool air everywhere in the cars, as well as in the subway tunnel and its stations.

STANDARD OF PURITY FOR AIR

Much has been written as to what constitutes good air and what is dangerous. The most important test is the determination of the parts of carbonic acid gas (CO_2) in a given sample per 10,000 volumes. Ordinary air varies considerably, during different kinds of weather, from about 1½ parts to more than 4 parts of carbonic acid gas per 10,000 volumes, but the ordinary figure is about 4 parts. The best authorities state that the air in any subway should not contain more than twice the amount of carbonic acid gas found in the outer air (the two being nearly always directly compared), and that therefore the general limit is 8 parts of carbonic acid gas per 10,000 volumes. The "Factory Act" of England makes 9 parts of carbonic acid gas as the maximum in rooms, etc. The report to the London County Council in 1902 places the safe limit at 8 parts, as being the maximum that should exist in the air of subways; and that report states further that the number of bacteria in subway air was generally found to increase and decrease in proportion to the carbonic acid gas in the air. The writer, while investigating this subject



RECORD OF THE WEATHER IN

Upper black line indicates temperature in degrees Fahr. Dotted line indicates relative humidity in per
S—Clear. PC—Partly Cloudy.

in London, during July, 1905, learned that public opinion is very strong in demanding air in subways that shall generally not contain more than 8 parts of carbonic acid gas per 10,000 volumes of air, and that periodical attacks by the press are made, substantiated by detailed reports of noted chemists, against any subway tunnel where, for a period, air is found to contain more than this quantity of carbonic acid gas. Hence, it may be stated that 8 parts of carbonic acid gas per 10,000 volumes is the maximum proportion of carbonic acid gas that should be allowed in the air of cars in subway tunnels.

The Weather During October

The weather generally throughout the country during the month of October was very near the average to be expected for this month. None of the reports received showed more than a trace of snow during the month, although in most localities more than the usual number of cloudy days was recorded.

NEW YORK

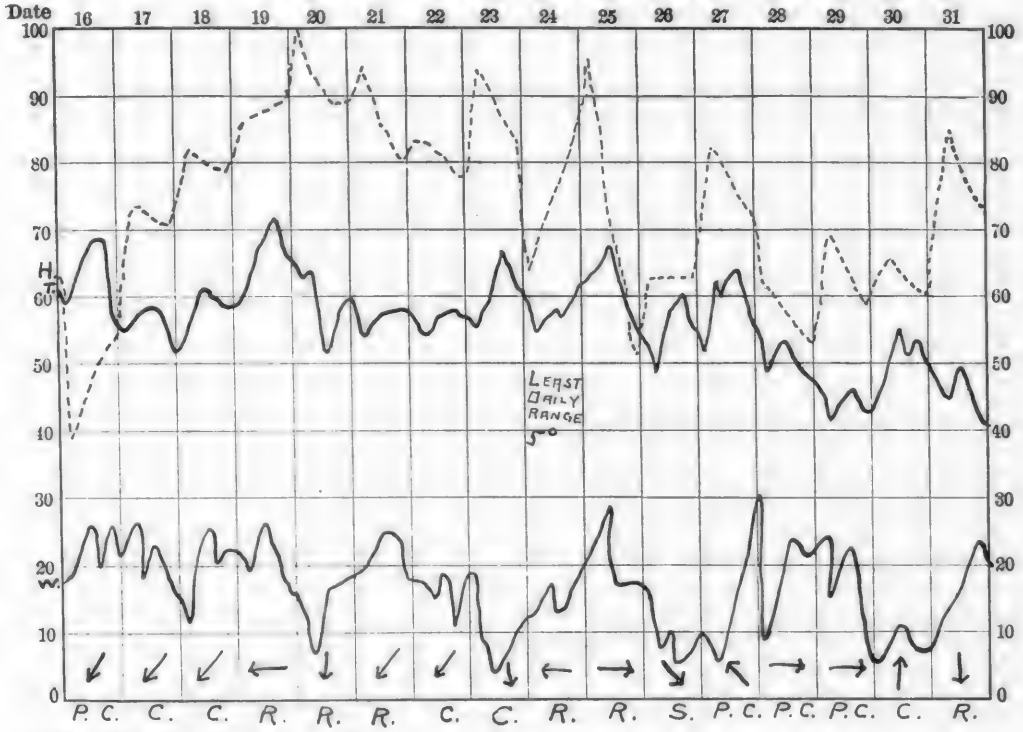
In New York, the highest temperature recorded was 74° on the 9th and the lowest, 37°, on the 12th. The greatest daily range was 26° on the 9th and the least daily range, 5° on the 24th. The mean temperature for the month was 56°, corresponding to the mean of this month for 36 years. There was 4.30 inches of rain, 1.21 inches falling on the 19th and 20th. This was somewhat above the average. The prevailing direction of the wind was northeast and the total movement 10,490 miles; average hourly velocity, 14.1 miles; maximum velocity for 5 minutes, 58 miles from the northwest on the 7th. There were 5 clear days, 10 days partly cloudy, 16 cloudy and 11 rainy.

BOSTON

In Boston the highest temperature was 73° on the 25th and the lowest, 35° on the 13th. The greatest daily range was 24°. The mean temperature for the month was 52.5°, which corresponds to the normal temperature for 36 years. The total rainfall for the month was 3.88 inches, slightly less than the average. The greatest rainfall in any one day was 2.16 inches; prevailing direction of the wind, northeast. There were 9 rainy days, 8 clear days, 10 days partly cloudy and 13 cloudy.

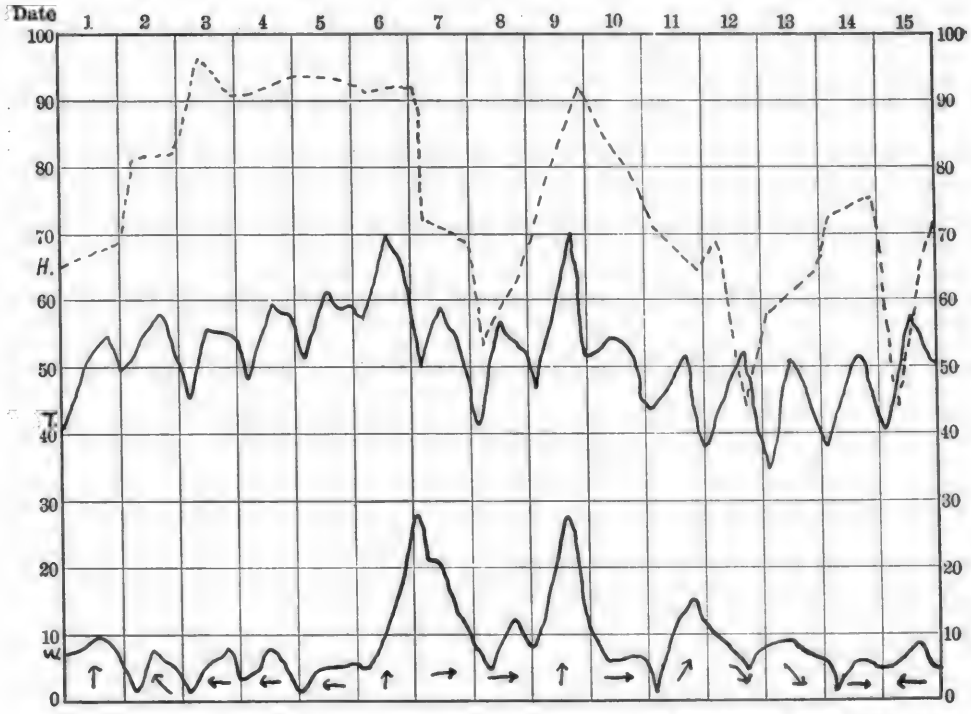
CHICAGO

In Chicago the mercury touched 75° on the 8th and 27° on the 11th. The greatest daily range was 30° on the 8th, and the least daily range, 4° on the 22nd. The mean temperature for the month was 53°, corresponding to the normal temperature or 36 years. During the month 2.05 inches of rain fell which is nearly half an



NEW YORK CITY FOR OCTOBER, 1906

centage. Lower line indicates velocity of wind in miles per hour. Arrows fly with prevailing direction of wind C—Cloudy. R—Rain.



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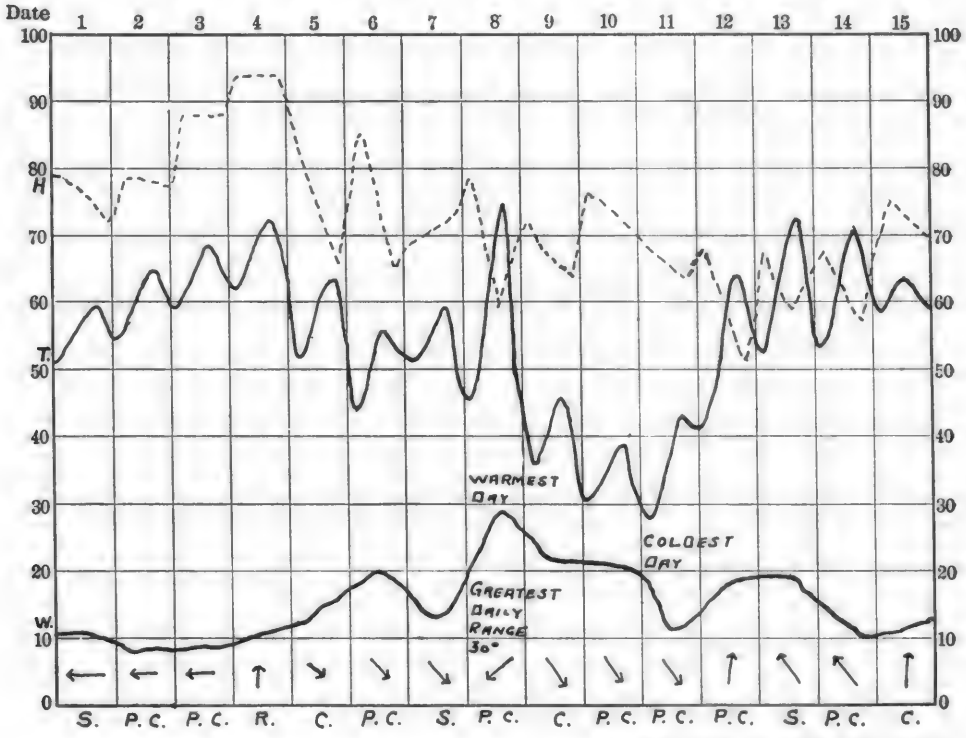

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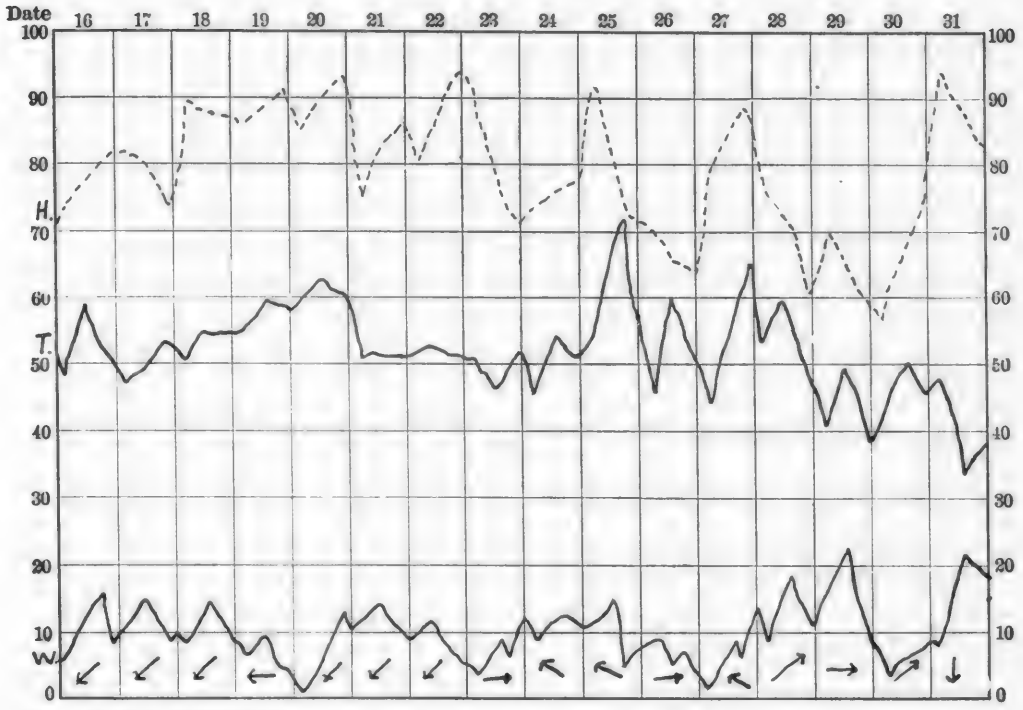
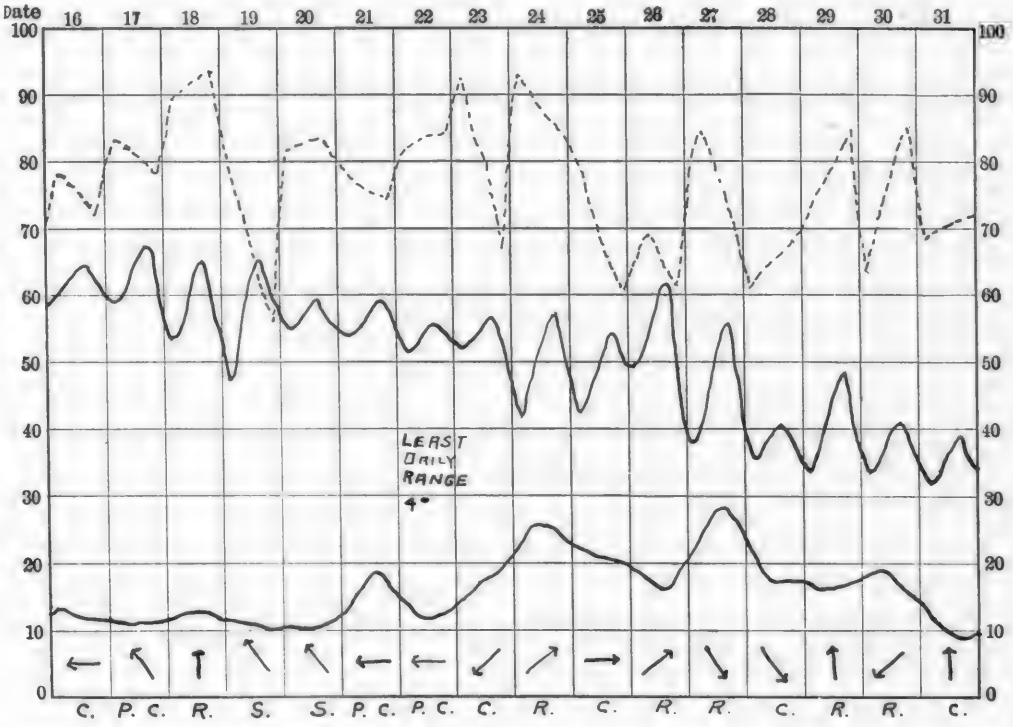


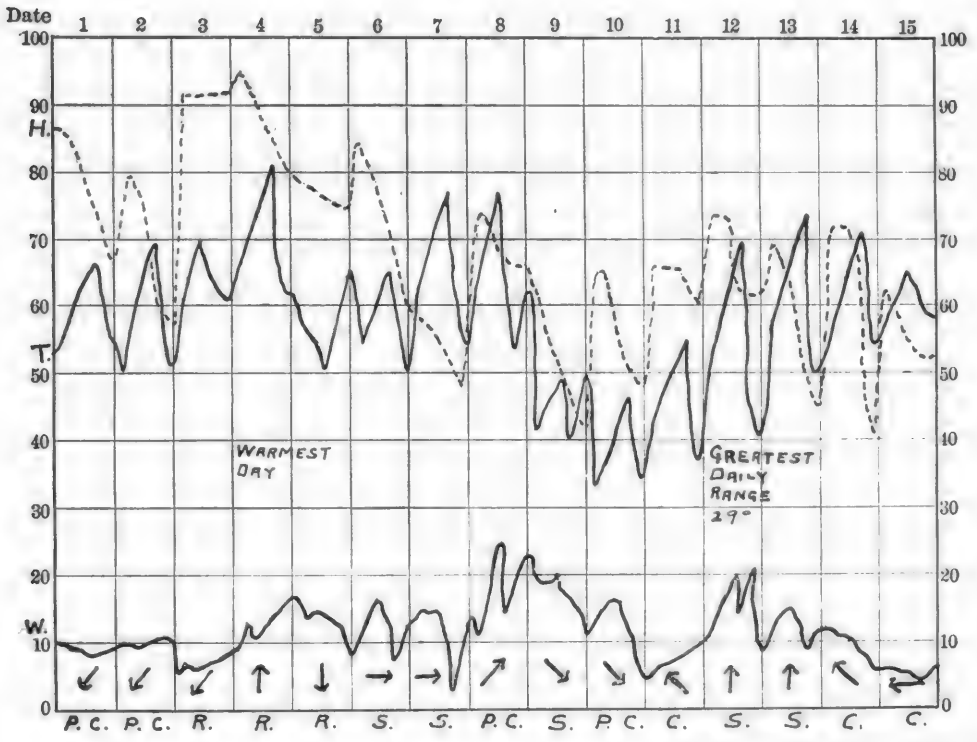
BOSTON FOR OCTOBER, 1906

centage, Lower line indicates velocity of wind in miles per hour. Arrows fly with prevailing direction of wind



CHICAGO FOR OCTOBER, 1906

centage. Lower line indicates velocity of wind in miles per hour. Arrows fly with prevailing direction of wind
C—Cloudy. R—Rain.



RECORD OF THE WEATHER IN

Upper black line indicates temperature in degrees Fahr. Dotted line indicates relative humidity in per
S—Clear. PC—Partly Cloudy.

inch below the average. The greatest amount of rain in any one day was .77 inches on the 17th; prevailing direction of the wind, northwest; total movement, 11,662 miles; average hourly velocity, 16 miles; maximum velocity for 5 minutes, 50 miles from the northwest on the 27th. There were 5 clear days, 11 partly cloudy, 15 cloudy and 7 rainy.

ST. LOUIS

The highest temperature recorded for the month was 81° on the 4th and the lowest, 30° on the 31st. The greatest daily range was 29° on the 12th, and the least daily range, 8° on the 24th. The mean temperature for the month was 57°, 2° below the average for 34 years. The total rainfall was 1.25 inches. The greatest rainfall in any one day occurred on the 23–24th, when 0.58 inches were recorded. The average rainfall for 26 years is 2.33 inches. The prevailing direction of the wind was northeast; total movement, 7,766 miles; average hourly velocity, 10.4 miles; maximum velocity for 5 minutes, 60 miles per hour from the northwest on the 27th. There were 9 clear days, 14 partly cloudy, 8 cloudy and 7 rainy.

A record-breaking list of 50 applications for membership in The American Society of Heating and Ventilating Engineers has been received this year.

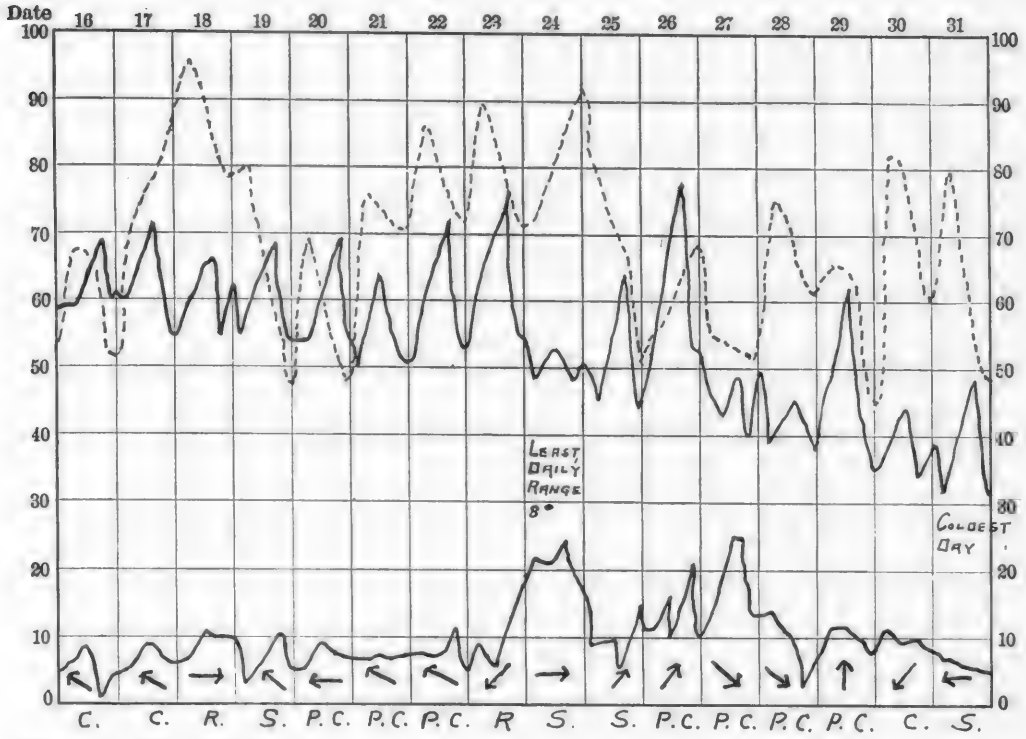
Position of Air Valve on Fan Heater Bases

No problem in the design of bases of heaters combined with fans for indirect radiation systems seems to be more blindly solved by manufacturers than that of the correct position of the air valve. There is nothing peculiar or unknown about the path of air travel in a heater for use with blowers. The principles that are followed in a radiator used in the direct

FIG. 1 SECTION OF FAN HEATER BASE, AIR VALVE BEING CONNECTED TO PIPE LEADING FROM DRIP CHAMBER TO TRAP

radiation system are based on fact and experience and the same principles hold in heaters used in connection with blowers.

Let us consider Fig. I. The steam entering the inlet finds its way into the piping of the heater as indicated by the arrows. The possibility of circulation, and the demand for more steam on the source of supply is due to the condensation of the steam in the pipes, which condensed steam—now water, trickles down the sides of the pipes and finds its way into either chamber *A* or *B*.



ST. LOUIS FOR OCTOBER, 1906

centage. Lower line indicates velocity of wind in miles per hour. Arrows fly with prevailing direction of wind. C—Cloudy. R—Rain.

The condensation from *A* finds its way to *C*, and hence to the drip outlet through a small hole in the separating web between the two chambers, while the condensation falling into *B* merely runs along the inside of the heater base bottom till it reaches the drip chamber; from which it is removed by connection to a trap.

In this type of heater base the air valve is connected to the pipe from the drip chamber to the trap. Hence the air valve can remove only the air which may be in chambers *A* and *C*. This is due to the fact that because the pressure is lower in *B* than in *A*—(due to condensation as described, which causes the steam to follow the circuit of the heater pipes), *steam* will always flow from *A* through the small hole, provided for condensation to reach drip chamber, to *C* and hence to *B*.

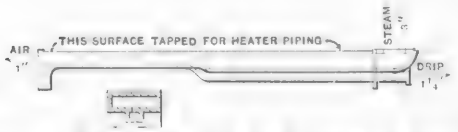


FIG. 2. ELEVATION OF FAN HEATER BASE WITH AIR VALVE AT BACK END

Therefore, while water may find its way from *B* to *C* by following the bottom of the heater base, the air in *B* cannot by any means buck the current of steam and reach *C*. Consequently the back portion of the heater coil will be air-locked the greater portion of the time.

Figure II shows how this difficulty is overcome in another type of heater base by placing the air valve connection on the back end where the pressure is least, where the air collects and its removal met with any opposition. By keeping the heater piping free of air an average of 0.44 lbs., a maximum of 0.6 lbs. and a minimum of 0.3 lbs. of steam per foot (of 1-inch pipe in heater) per hour at an actual velocity of air of 1,000 ft. per minute through the "clear area," *i. e.*, figuring area as that portion of cross section of heater not occupied by piping.

This corresponds to a velocity of about 400 feet per minute, if the entire cross-section of the heater be considered. The above, however, is correct only for low steam pressure, a pound or two being the maximum. If the steam at 80 pounds pressure be used the condensation will be almost twice as much. The entering air temperature considered is 0 degree F.

RICHARD C. WILLIAMS.

Note-Book for Use in Ventilation Tests

In his paper on "Air Analysis as an Aid to the Ventilating Engineer" which appeared in our October issue, Mr. J. Roger Preston, the author, described a note-book which he had used in jotting down

	Index.	
	What place and for what purpose used.	
	Cubic contents.	
	Height.	
	No. of occupants in room at time of test.	
	No. of occupants in ordinary way.	
	Space per person.	
	What method of lighting.	
	Date and time of test.	
	Temp. wet bulb.	
	Temp. dry bulb.	
	Barometric pressure.	
	Time room occupied.	
	Vols. CO_2 per 10,000.	Outside.
		Inside.
	How taken, whether D or B.	
	Position in which sample taken.	
	Method of ventilation in actual use at time of test.	

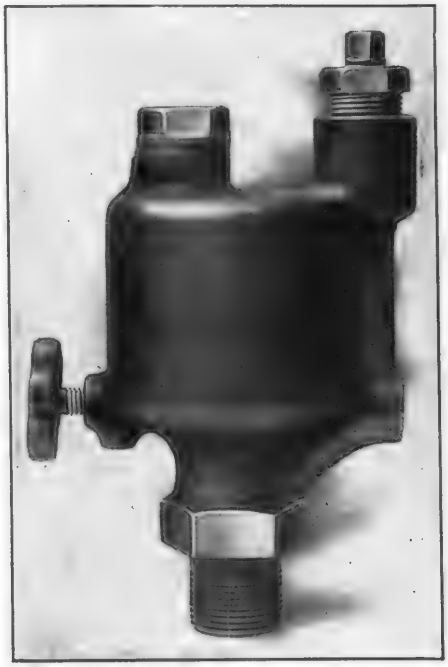
NOTE BOOK FOR USE IN MAKING VENTILATION TESTS

data regarding his tests. This note-book is made with squared paper on one side for plotting the results and noting any special conditions. A copy of the other side of the note-book is reproduced herewith. Commenting upon its form, Mr. Preston says that there could be more divisions with advantage, but when getting them printed, they were designed to go into the pocket.

"The only item," he says, "which it may be inconvenient sometimes to obtain is the temperature of the wet bulb. The temperature of the dry bulb is rather important and a small pocket thermometer is easily carried."

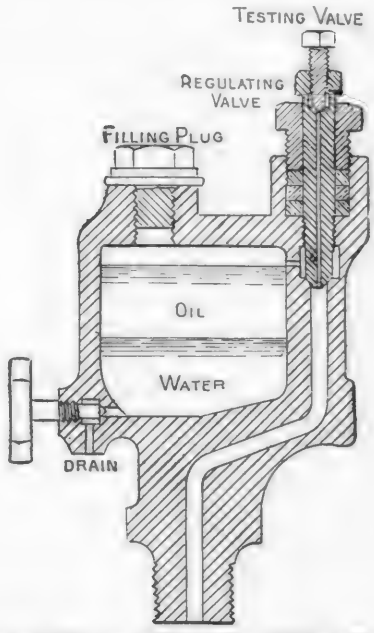
NEW DEVICES

Leyland Automatic Oil Cup is a new device for feeding lubricant to steam actuated cylinders, which is attracting much attention on account of its simplicity of construction. The oil cup is both automatic and controllable and is found to require no more attention in operation and scarcely in construction than an ordinary bearing cup. The only radical difference between it and the



LEYLAND AUTOMATIC OIL CUP

ordinary oil or grease cup is that it discharges at the top instead of the bottom, the oil being conveyed to the screwed connection by a passage in the side, as shown in the sectional view. In addition to this feature there is a drip valve at the bottom, a filling plug above the cup. The cup is attached to the steam-chest or to the pipe below the throttle valve. When steam is admitted it passes up the cored passage at the side into the space on top of the oil, and condensing, settles through the oil, raising the level of the latter so that it passes out and follows down the same passage by which the steam enters. This action is intensified by the fluctuating pressure due to the intermittent demand of the cylinder, a positive outflow from the cup being occasioned each time that the pressure in the side passage is reduced by the opening of the



CROSS-SECTION LEYLAND AUTOMATIC OIL CUP

admission valve. The regulating valve being once set at the point which will give the required feed, the cup requires no further attention, will feed a very little oil every time the engine takes steam, and stops feeding when the steam is shut off. When the oil is all gone, the regulating valve is closed, the filling plug removed, the drain opened and the water allowed to escape, when the cup is refilled with oil and put back into service.

The body of the cup being directly attached to the hot chest, or pipe, assumes a temperature which keeps its contents at a consistency that enables it to handle successfully not only heavy oils, but greases. The testing valve is made to fit any size cup and is used for the purpose of finding at any time whether the cup is empty; until regulating valve is once set to meet requirements, when oil shows at the above outlet of testing valve the cup is feeding oil, when steam

is emitted it is known the cup is empty.

It is made of both brass and cast iron in one quart, one pint, and one-half pint capacity.

This device is manufactured by the Empire State Engineering Company, New York, who will be glad to furnish further information to those interested.

National Hot Water Tank Regulator, illustrated herewith, is an interesting device that has been placed on the market by the National Regulator Company. It consists of a thermostat and a diaphragm steam valve, if a steam coil furnishes the heat; or a thermostat and a diaphragm motor to be connected to the check and draft door, if a coal burning heater is used. The thermostat is the same in each case. The power for operating may be either compressed air or water.

If an air operated sewage ejector system is in use in the building, the air supply can be taken from it. If the regulator is to be operated by water pressure, a filterer is furnished with the regulator through which the water passes before reaching the thermostat.

This tank thermostat is noticeable for its simplicity. There are no coil springs,

NATIONAL HOT WATER TANK REGULATOR

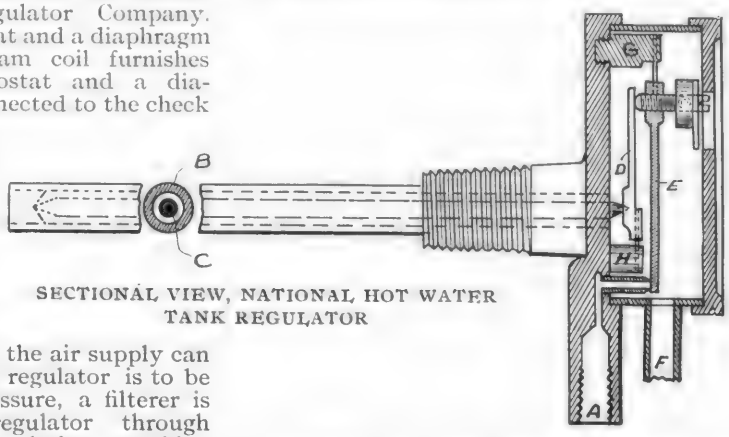
volatile liquids, diaphragms, or leather-faced valves. The only bearings are phospher bronze plate springs, on which dirt would have no effect.

In the cut, *B* is a brass tube; *C* is a heavily-plated steel rod, bearing at one end on a plug in the end of the tube, and at the other end on a lever *D*. *E* is a second lever to multiply the movement, one end of *E* being the valve which opens or closes the port at the outlet of pipe *A*.

The levers are attached to posts *G* and *H* by means of phospher bronze plate springs, which serve to permit movement and provide tension to return the levers when the pressure, which has moved them in one direction, is lessened.

—The motive power, air or water under pressure, is brought to the thermostat in pipe *A*, after passing a restriction which controls the amount thereof, to prevent waste.

—In operation, when the water in the tank becomes warmer, the brass tube *B* expands more than the steel rod *C*, thus decreasing the pressure of the rod on lever



SECTIONAL VIEW, NATIONAL HOT WATER TANK REGULATOR

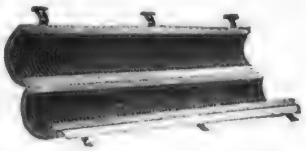
D, allowing the plate springs to close the outlet of pipe *A*, causing the fluid pressure to accumulate in the diaphragm steam valve and shut off the steam supply. When the water in the tank cools, the tube *B* contracts more than *C*, the latter pushes open the valve, allowing the pressure fluid to escape and the steam valve responds by admitting steam to the coil.

The thermostat does this gradually, proportioning the amount of steam admitted to the coil to the demand for heat; and maintaining the steam valve in a partially open position as long as the temperature of the water holds at a corresponding point.

When the regulator is to be used with a coal burning heater, a diaphragm motor is furnished to be fastened above the heater, and to be connected by chains to the draft and check doors.

The thermostat in this case causes the draft of the heater to vary as does the temperature of the water in the tank.

"Asbestocel" Covering, manufactured by the H. W. Johns-Manville Company,



TYPE OF ASBESTOCEL PIPE COVERING

New York, is distinguished as being not only an insulator of high efficiency, but also fire-proof and meeting the requirements of the fire underwriters. This covering is made entirely of asbestos and is con-

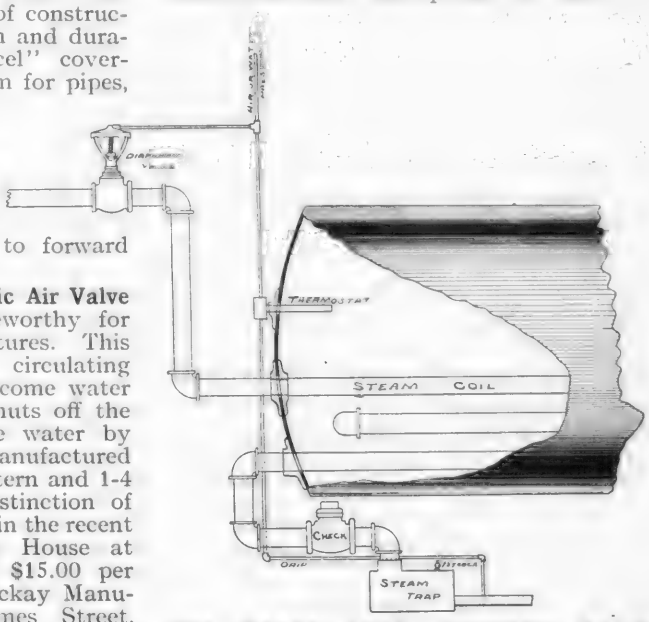
sidered an improvement over the ordinary air cell covering in that the corrugation run around the pipe instead of lengthwise, thus preventing all circulation of air and consequent radiation of heat. The covering is built on the arch form of construction which adds to its strength and durability. All of the "Asbestocel" coverings are made in sectional form for pipes, in sheets and blocks for large heating surfaces and in paper for hot air pipes. The manufacturers have recently published the results of actual tests made of this covering which they would be glad to forward to those interested.

"W. M. Mackay" Automatic Air Valve for steam radiators are noteworthy for their many advantageous features. This valve is a double passage circulating syphon valve and will not become water logged. In its operation it shuts off the steam by expansion and the water by floatation. The valve is manufactured both in the 1-8 inch angle pattern and 1-4 inch straight. It has the distinction of having been specified and used in the recent reconstruction of the White House at Washington. It is listed at $15.00 per dozen and is sold by the Mackay Manufacturing Company, 62 James Street, Newark, N. J.

Trade Literature

Ideal Fitter, published by the American Radiator Company, and containing list prices in effect September 15, 1906 is out.

It is a most complete catalogue and price list, containing 312 pages. The book measures 3 3-4x6 1-2 inches. All of the company's well-known makes of boilers and radiators, including its new types, are illustrated and concisely described for quick reference. The book also contains illustrations and descriptions of most of the better known specialties used in heating work, including the Morgan vacuum valves, Norwall automatic air and vacuum valves and Norwall automatic air valves. Twenty pages at the back of the book are devoted to a store of well-edited miscellaneous information, dealing with chimney flues, greenhouse capacities and heating and ventilating data, concluding with a telegraph code for all of the goods described in the preceding pages. Copies of the Ideal Fitter may be had by addressing the American Radiator Company, at Chicago.



HOT WATER TANK, EQUIPPED WITH NATIONAL HOT WATER TANK REGULATOR

The "Brueckner" System of rapid circulation in hot water heating, in use for some years in Europe, has been recently introduced in this country, the United States representative being Arthur J. Herschmann, 25 Broad Street, New York, Member of the American Society of Mechanical Engineers. This system, as described in the company's catalogue, is the ordinary low pressure hot water system with the addition of mixing tubes fixed in the flow and return pipes at particular distances below the expansion tank, and may be introduced into any existing apparatus where a quicker circulation and greater heat are desired, always provided the boiler is large enough for its work. The catalogue contains numerous illustrations showing a typical installation on a two-pipe system and on a one-pipe system. Another sketch illustrates an installation where the radiators are heated

on the floor below the boiler, showing the arrangement of piping for both two-pipe and one-pipe plants. Still another sketch illustrates an arrangement with radiators above and below the boiler and extending across a roadway to an outbuilding.

Death of Carleton Walworth Nason

Carleton Walworth Nason, president of the Nason Manufacturing Company, 71 Fulton street, New York, died November 4 last, of pneumonia, at his home in New York City. Mr. Nason was 57 years old. His name, together with that of his father, Joseph Nason, will always be associated with many of the more important advances made in the steam fitting and steam heating industry in this country. As a man, Mr. Nason possessed a most winning personality. A refined and cultured gentleman and an authority on matters pertaining to the manufacture of steam fitting goods, he was ready at all times to share his knowledge with inquirers and the technical press in particular is indebted to him for much information that has appeared from time to time in its columns.

Mr. Nason gained considerable distinction as an inventor. His improved pneumatic lift has long been in use in the offices of the company. He was one of the first manufacturers of a wrought-iron steam radiator used largely in the United States navy. To enable him to make these radiators single tube, screwed into a hollow base, Mr. Nason invented a sheet iron diaphragm running almost the length of the tube and dividing it into two sections. This diaphragm was fluted like a letter S to hold it rigidly in place. A number of machines used in the manufacture of these radiators, such as a tube welding machine, a machine for boring several holes simultaneously in the base of the radiator and a machine for forcing the diaphragms into the radiator tubes, were all designed by Mr. Nason. He also designed a wrought-iron boiler for house heating, notable for its high efficiency. So modest, however, was Mr. Nason regarding his attainments as an inventor that but few of his inventions were patented and only he, himself, and his immediate associates knew of many of them.

Mr. Nason, however, had always a keen interest in the advancement of the steam fitting industry and when the question of a schedule of standard flanges was brought up in the early 80's, Mr. Nason was made chairman of a committee representing the American Society of Mechanical Engineers and the adoption in 1884 of a schedule of standard flanges for pressures up to 200 pounds and for pipe sizes from 2 to 48 inches was the result of the work of this committee, working in conjunction with representatives of manufacturers and contractors. Mr. Nason took an active interest in the work of the New York Trade School and served for many years on the committee of the General Institute of Mechanics and Tradesmen, which maintains a scholarship at the Trade School.

Mr. Nason was born in Woburn, Mass. in 1849. At that time, his father, Joseph Nason, the inventor of the globe valve and of the Nason steam trap, was a partner in the firm of Walworth & Nason, of Boston. Two years later, Mr. Joseph Nason moved to New York with his family and established a branch of the Boston house. After several changes, the late Henry R. Worthington, became a partner, and the firm's name was changed to Joseph Nason & Company. In the meantime, Carleton W. Nason had attended school in New York and later entered the School of Mines, at Columbia. He left college before graduating and at the age of 18 entered his father's shop, later taking up office work. After his father's death, in 1872, the firm's name was changed to the Nason Manufacturing Company, at which time he was made vice-president. He took entire charge of the business in 1884.

Mr. Nason married in 1876, Lucia G. Olmstead, daughter of Isaac T. Olmstead, of New York. His wife died in 1885, leaving no children.

Mr. Nason was an ardent yachtman and was a member of the New York and Atlantic Yacht Clubs. He also held membership in several other bodies, including the American Society of Mechanical Engineers.

The funeral services were held November 6, at All Souls Unitarian Church, New York, the Rev. Dr. Slicer officiating. The burial was at Mt. Auburn Cemetery, Cambridge, Mass. Mr. Nason leaves two sisters. Among his cousins is Mr. Arthur C. Walworth, of Boston.

Charles Hawley Pierce, of the Pierce, Butler & Pierce Manufacturing Company, Syracuse, N. Y., October 31 last, of appendicitis. He was 57 years old.

Business Etiquette

Foreign merchants are, as a class, much more punctilious in their observance of business etiquette than Americans, and for this reason their correspondence is usually much pleasanter reading. They are extremely quick to detect any lack of business courtesy on the part of their correspondents, and even inclined to resent as a personal affront the somewhat brusque statements often found in American business letters. This goes a long way toward explaining why some export advertisers, although they may receive many replies to their advertisements, rarely succeed in establishing lasting business relations with those who answer their advertisements.—*Commercial Advertiser.*

TRADE AND MISCELLANEOUS NOTES

William Walker, of the firm of Walker & Chambers, heating and ventilating contractors, died of consumption at his home in Summit, N. J., October 30th. He was 38 years old. At an early age Mr. Walker went into the employ of Baker, Smith & Company, and later was at the head of that firm's engineering department. In 1899 he left Baker, Smith & Company, and with A. N. Chambers, of the Newburgh Boiler Company, organized the firm of Walker & Chambers. This company has become one of the best-known heating and ventilating contracting firms in the city. Mr. A. N. Chambers served for several years as treasurer of the National Master Steam Fitters' Association. Mr. Walker leaves a widow and two children. During the past year Mr. Walker had seldom been able to be at his desk and as a consequence his duties have been undertaken by others in the office, so that the business of the company will not be affected by his death.

Miscellaneous Notes

N. O. Nelson, of the N. O. Nelson Mfg. Company, St. Louis, Mo., contributes an article to "American Industries" in its issue of October 15th last on "How They Manufacture and Live Co-operatively in Leclaire." Mr. Nelson took a leading part in the founding of Leclaire in 1890, where the experiment of profit sharing with employees has been tried with success. All of the employees and customers of the N. O. Nelson Mfg. Company, which owns the factories and unsold lots (farmed until built on) in Leclaire, share the profits of the entire business on equal terms. Together they get all the profits except 6 per cent. on the stock already held by them.

Central Supply Association held its twelfth annual meeting in Cleveland, Ohio, October 24. Among the more important actions taken at the meeting was the unanimous adoption of the following resolution:

Resolved: that no member of this association shall accept any offer for material with the following or any other similar condition, "this order is given on condition that the firms supplying the goods will pay for replacing any part that, when tested, is found defective." This condition is one that has been in use by a number of the local associations of the National Association of Master Steam and Hot Water Fitters. The following officers were elected to serve for the ensuing year: President, John D. Hibbard; First Vice-President, S. H. Moon; Second Vice-President, George H. Merkel; Treasurer, Edward F. Niedecken; Secretary, Paul Blatchford; Executive Committee, in addition to the above officers, J. M. Young, William Ivy L. C. Heusmann, J. B. Rahm; Members of National Committee: Members, James Harvey, John F. Wolff, N. O. Nelson, H. L. Andrews, J. B. Rahm; Alternates, W. G. Callow, F. K. Dibley, George H. Gorton, Otto F. Felix, John D. Hibbard.

Eastern Trade Golf Association held its Fall meet October 25 on the links of the Fox Hills Golf Club, Clifton, Staten Island. Nineteen players teed up for the various competitions which were played under fair skies, but on the somewhat wet green, owing to the rains of the previous days. Frank B. Barrett scored a second win on the Club challenge cup, presented by

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have been the **STANDARD** for over **THIRTY-TWO YEARS.** For returning water under pressure to the boiler, they will perform this duty fully as well, and in many cases better than the so-called steam loop.

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Frank C. McLain, by returning the lowest gross score of the day, 48–46, 94. After a qualifying round in the morning, the players were divided into four flights and the leading two in each flight were awarded cups. The winners were: First flight, Frank B. Barrett and A. E. Barron; second flight, M. E. Danforth and E. H. Roberts; third flight, A. W. Maine, Jr. and Howard W. Walton; fourth flight, A. A. Ainsworth and Frank K. Chew. In addition to these matches, a team match was arranged against a team representing the Master Fitters' Association. The golf association team was made up of E. C. Molby (Captain), A. E. Barron, M. E. Danforth, A. W. Maine, Jr., and E. H. Roberts, while on the Steam Fitters' team were, C. G. Rowe, Howard S. Hadden, E. W. Herrick, C. D. Cowan and C. N. Brisze (Captain). This match resulted in a victory for the Eastern Trade Golf Association, the score being 8 to 3. Each member of the winning team was presented with a cup and later the players partook of Captain Brisze's hospitality at Haan's restaurant in New York. A visitor's cup, presented by *The Metal Worker*, was won by Howard S. Hadden with a score of 90.

Wm. M. Mackay, New York, has rented an office from the Hart & Crouse Company, 235 Water street, where he will continue his business as consulting engineer.

Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., will hold its decennial Founder's Day exercises in the chapel hall of the institution, Friday, November 30, 1906. The memorial exercises will be in charge of Bishop William C. Doane, of Albany. The Founder's Day address will be delivered by Dr. Henry Smith Pritchett, President of the Carnegie foundation for the Advancement of Teaching.

National Founders' Association has published, under date of September 1, 1906, a list of open and non-union foundries. The list is published in response to many inquiries from independent moulders and coremakers as to where they can secure employment without being subjected to union restrictions. It is announced that this list is only a selection, as it has been thought better to insert in it only a few names rather than include many foundries which are only theoretically open shops. Among the names of manufacturers of heating and ventilating goods, we note the following: Malleable Iron Fittings Company, Branford, Conn.; Bridgeport Malleable Iron Company, Bridgeport, Conn. The Crane Company, Chicago, Ill.; Illinois Malleable Iron Company, Chicago, Ill.; L. Wolff Manufacturing Company, Chicago, Ill.; Kewanee Boiler Company, Kewanee, Ill.; Moline Pump Company, Moline, Ill.; Dean Brothers Steam Pump Works, Indianapolis, Ind.; Chapman Valve Manufacturing Company, Indian Orchard, Mass.; American Radiator Company, Detroit, Mich.; United States Heater Company, Detroit, Mich.; Cox & Sons Company, Bridgeton, N. J.; Garwood Foundry & Machine Company, Garwood, N. J.; Trenton Malleable Iron Company, Trenton, N. J.; American District Steam Company, Buffalo, N. Y.; American Radiator Company, Bond Plant and Standard Plant, Buffalo, N. Y.; Buffalo Radiator Company, Buffalo, N.Y.; Niagara Radiator Company,

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¶ The sales of Norwall Automatic Air Valves are running nearly double those of last year. ¶ The sales of Norwall Automatic Air and Vacuum Valves are running over three times those of last year. ¶ Users of NORWALL VALVES keep on using them. ¶ Enough said—but let us tell you why these facts are true, and show you what these valves will do.

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Buffalo, N. Y.; United States Radiator Works, Dunkirk, N. Y.; The Herendeen Manufacturing Company, Geneva, N. Y.; Abendroth & Root Manufacturing Company, Newburgh, N. Y.; Central Foundry Company, New York; Kennedy Valve Manufacturing Company, New York; Abendroth Brothers, Port Chester, N. Y.; Cast Thread Fittings & Foundry Company, Seneca Falls, N. Y.; Giblin & Company, Utica, N. Y.; International Heater Company, Utica, N. Y.; Utica Heater Company, Utica, N. Y.; Utica Pipe Foundry Company, Utica, N. Y.; Stirling Consolidated Boiler Company, Barberton, Ohio; Harrison Safety Boiler Works, Philadelphia, Pa.; Stanley G. Flagg & Company, Pottstown, Pa.; R. J. Schwab & Sons Company, Milwaukee, Wis.

Manufacturers' Notes.

McCrum-Howell Company, New York, announces that Philip Y. Linker, who has been in the heating department of the J. L. Mott Iron Works, will cover the Brooklyn and Staten Island territory for this company. The company has also secured the services of Mr. Hyndman, who will have his headquarters at Scranton, to cover northern Pennsylvania. Mr. Hyndman was formerly with Bridgman Brothers Company, of Philadelphia, Pa., and covered the same territory for that firm. Mr. Frank P. Richardson, in the home office, will have charge of the sales of the Penn enameled ware. Mr. Richardson was formerly buyer for the Colwell Lead Company.

Kinnear Pressed Radiator Co., Pittsburg, Pa., has changed the name of the company to "The Pressed Radiator Company."

Buffalo Forge Co., Buffalo, N. Y., has increased its capital stock from $1,000,000 to $1,250,000. A large amount of this increase will be used to enlarge the company's plant at Broadway and Spring streets and to extend the foreign trade. One of the new buildings will be 125x215x 32 feet in height and constructed of brick and steel. It will be used for the sheet metal manufacturing departments.

Sodemann Heat & Power Co., Edwardsville, Ill., had its plant destroyed by fire October 15th. The loss is about $50,000, and the insurance $25,000.

H. W. Johns-Manville Co., New York, will move its Boston office, now 77 Pearl street to the building at 55 High street, which the company has leased, about December 1st.

The Howe Manufacturing Co., Louisville, Ky., and Blake & Andros, Boston, Mass., have dissolved by mutual consent the connection formed April 1, 1905.

L. F. Beers has taken charge of the Detroit office of the Buffalo Forge Company, succeeding H. M. Brightman, who is now connected with the Terry Engineer-

"W. M. MACKAY"
AUTOMATIC
AIR VALVES
FOR STEAM RADIATORS

Positively the Best Air Valves Made

Steam and Hot Water Valves and Heating Specialties

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For regulating pressure, set a new standard for sensitiveness, reliability, and speedy action.

THE FOSTER "CLASS Q" OR "CLASS QH" VALVES

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"Class Q" has equalled sized inlet and outlet. "Class QH" has a small inlet and a large outlet.

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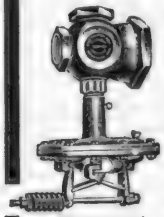
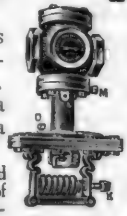

"Class QH" Valve


"Class Q" Valve

Foster Engineering Co.,
NEWARK, N. J.

ing and Construction Company, of Grand Rapids, Mich.

Warren, Webster & Co., Camden, N. J., have filed a bill of complaint in the Circuit court of the United States Eastern Division, Northern District of Illinois, in equity, asking a restraining injunction against the Consolidated Engineering Company from further utterance of circulation of circulars, notices, etc., charging infringment against Warren Webster & Company. This bill of complaint has been filed through their attorney, Randall W. Burns, solicitor, and Ernest Howard Hunter, counsel, and is the result of statements that have been made by the Consolidated Engineering Company in the shape of an infringement notice dated August 25, in which statements are made reflecting on the water seal motor valve made by Warren Webster & Company, as an infringement of a patent issued to them on August 7, 1906.

McCrum-Howell Co., boiler and radiator manufacturers, New York, has mailed samples of its improved form for estimating to the steam and hot water fitting trade. The forms are conveniently arranged for figuring both steam and hot water work, and are supplied free to the trade. Application should be made direct to the home office or to one of the branches. It is desired that mention be made of THE HEATING AND VENTILATING MAGAZINE.

H. H. Seabrook has been elected president of the Nason Manufacturing Company, to fill the vacancy caused by the death of Mr. Carleton W. Nason. Though not previously connected with the firm, in an official capacity, Mr. Seabrook, as the late Mr. Nason's brother-in-law, has frequently acted for the firm during Mr. Nason's absence.

Toledo Pipe Threading Machine Co., Toledo, Ohio, have moved their factory from Sandusky to Toledo.

New Incorporations

Equitable Steam Specialty Co., Baltimore, Md., has been incorporated with a capital of $20,000. The incorporators are: M. H. Jones, George L. Sleight, F. E. Dodson, T. H. Embert and M. C. Jones.

Globe Hot Water Manufacturing Co., Brooklyn, N. Y., has been incorporated with a capital of $10,000. The incorporators are: Hyman Goldman, Leon Wechsler and Leon Jacobson.

South Norwalk Flanged Fittings Corporation, Jersey City, N. J., has been incorporated with a capital of $000,000. The incorporators are: H. L. Coughlin, Thomas F. Barrett, B. Schaub, J. R. Trimmer and L. H. Gunther.

J. W. Beck Light, Heat & Power Co., Carthage, Ind., has been incorporated with a capital of $10,000, to supply heat, light

We recently exhibited and operated our Thermostats for a distinguished Ohio architect, and later, at his request, sent him a list of references, both as to our financial strength and our installations. He writes us under date of October 3d, 1906:

"Gentlemen:—I have yours of the 20th ultimo, with enclosures, all of which I have carefully noted. Your endorsements are very substantial. I shall be glad to consider a proposition from you on any future work I may have.

"Thanking you for your list of references, I remain."

We showed our Thermostat to one of the leading Detroit architects, some time since, taking it to pieces and comparing it with thermostats of other makes similarly dismantled. His remark was, "Well, if your machine works at all, you have the others skinned to death."

Five years' use proved they not only work, but continue to work.

We will be glad to show them to you, and operate them in your presence, if you say the word.

NATIONAL REGULATOR COMPANY,

CHICAGO
334 Dearborn Street

NEW YORK
1135 Broadway

and power. The directors are: John W. Beck, Jesse C. Overman and D. S. Beck.

Motor Car Heater Co., Chicago, Ill., has been incorporated with a capital of $2,500. The incorporators are: W. C. Lewis, Helen E. Robin and J. L. Brouse.

Syracuse Steam Gauge Manufacturing Co., Syracuse, N. Y., has been incorporated with a capital of $50,000 to manufacture pressure and vacuum gauges. The incorporators are: Leland Wiliis, Frank H. Graham, Harry H. Farmer and Gustave F. E. Meistering.

Monarch Heating & Radiating Co., Greensboro, N. C., has been incorporated with a capital of $150,000 to manufacture and install heater and radiating system and carry on a general machinery business. The stockholders are: M. L. Coble, F. A. Silver, E. W. Lyon and V. C. McAdoo.

Walter L. Flower Specialty Co., St. Louis, Mo., has been incorporated to manufacture and deal in steam specialities and material used in connection with the construction of steam and power plants. The incorporators are: Walter L. Flower, Norman Stewart and Joseph B. Bell.

Buffalo Blower Co., Buffalo, N. Y., has been incorporated with a capital of $10,000 to manufacture blowers, forges and engines. The incorporators are: W. F. Wendt, H. W. Wendt and W. F. S. Lake.

Berry Ventilator Co., Augusta, Me., has been incorporated with a capital of $10,000 to manufacture ventilators. The incorporators are: W. S. Lee, E. J. Pike, and C. L. Andrews.

Chances for Business

Washington, D. C., sealed proposals will be received at the office of the Supervising Architect, Treasury Department, until 3 P. M., November 21, 1906, for the construction of the U. S. Government buildings (excepting the Life Saving Station) at the Jamestown Exposition, Jamestown, Virginia.

State Agricultural and **Mechanical College,** Austin, Texas, is arranging to build a complete steam heating plant to cost about $80,000.

Frank A. Miller, proprietor of the Hotel Glenwood, is preparing to build a $1,000,000 hotel in the Yosemite Valley, which will be equipped with steam heating and ventilating plants.

Contracts Awarded

T. P. Riley, Fargo, N. D., installing a steam heating plant in C. H. Brown's residence. The consideration is about $1,400.

EMPIRE STATE ENGINEERING COMPANY ENGINEERS AND —MACHINISTS—

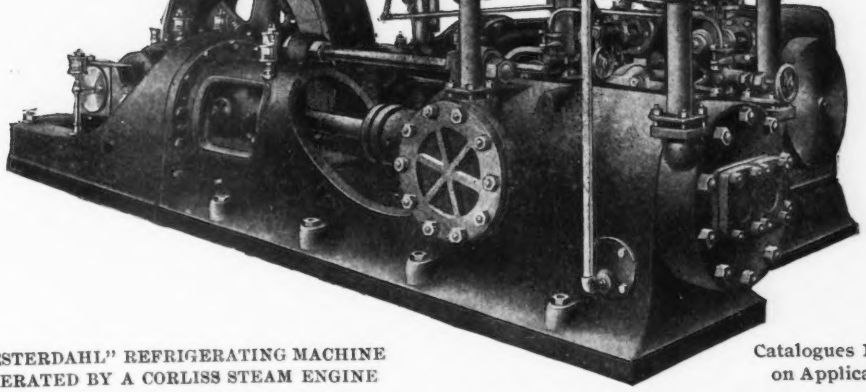
Builders of **ENGINES**

Ice and Refrigerating Machinery
Fans and Blowers

The Maxfield Steam Engine

For belting or direct connecting to dynamos, pumps, blowers, stokers, disc fans and general power. 3 H. P. to 30 H. P. All speeds. Small space.

Dust proof, durable, simple, efficient.



"VESTERDAHL" REFRIGERATING MACHINE OPERATED BY A CORLISS STEAM ENGINE

Catalogues Mailed on Application

OFFICE AND WORKS: Foot of East 116th Street, NEW YORK

W. S. Patterson Plumbing & Heating Co., Appleton, Wis., heating and plumbing the New London grade school.

Miller-Kane Co., Wilkinsburg, Pa., heating and ventilating the new $135,000 Second Ward Public School, also an apartment building.

Johnson & Beck, Topeka, Kan., heating and plumbing the Santa Fe reading and rest room at Chillicothe, Ill. The contract is worth $3.500.

Nelson & Heimark, Valley City, N. D., installing the steam heating plant in the Dazey school.

John S. Brause, Kutztown, Pa., heating the Metropolitan House.

Grimes-Kellhofer Co., Portsmouth, Ohio, heating the Methodist Church at Manchester.

J. C. Bixby & Son, Council Bluffs, Ia., heating the Pioneer Implement Company's new building.

C. H. Turner Co., Parkersburg, W. Va., heating and plumbing the new school house.

Biggs & Moore, Waverly, Ia., heating and plumbing the new addition to the Orphans' Home.

Emig & Hatmaker, Geneva, N. Y., heating and plumbing the Geneva Public School.

National Blower Co., Milwaukee, Wis., installing the heating plant in a new school building at Glenwood.

A. Burlingame Co., Worcester, Mass., heating the new laboratory building for the Worcester Polytechnic Institute.

J. E. Bromell, Mount Vernon, S. D., installing the heating plant in the new school building.

H. Kelly & Co., Minneapolis, Minn., installing a power and heating plant in the Butler Building.

Kaar Supply Co., St. Louis, Mo., heating the new Henry Raab school, at their bid of $5,692.

Kewanee Sanitary Supply Co., Princeton, Ill., heating and plumbing the Deaconess Home at Dover.

Northern Plumbing & Heating Co., Virginia, Minn., heating and plumbing the new Shanedling Block.

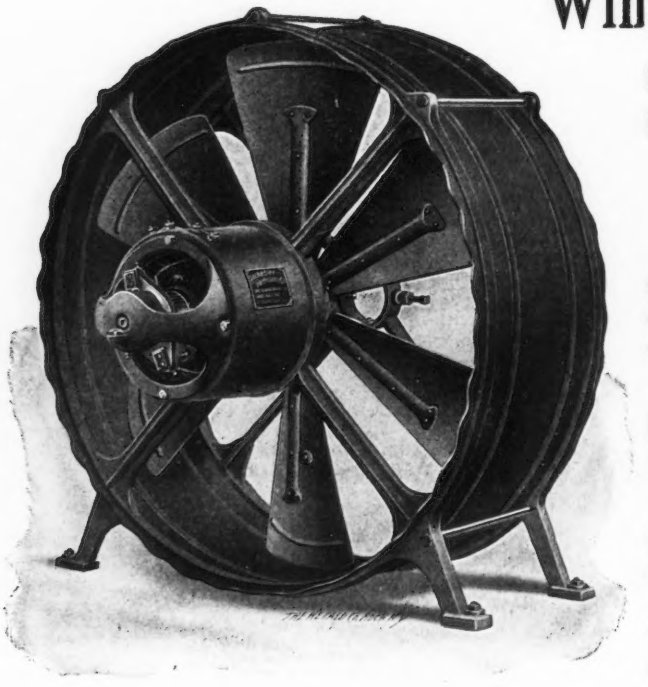
William Klingengan & Co., Boston, Mass., steam heating the American Velvet Company's new storehouse in Stonington, Conn.

La Velle & Hogan, Sioux City, Ia., installing a central heating plant in Wayne, Neb.

Charles G. Jewett, Howell, Mich., heating and plumbing the new State Sanitarium for the Treatment of Tuberculosis. The contract is worth $6,000.

J. P. Barry & Co., Woonsocket, R. I., steam heating and plumbing the Poor Farm at Uxbridge, Mass.

Warren Webster & Co., Camden, N. J., repairing the heating system at the County Asylum for the Burlington County Free-



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Send for Catalogue and Reference List of some 800 names of users.

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WING'S Disc Fan and Combinations
WING'S Fans and Turbine Engines for Forced Draft, etc.
WING'S High Speed Steam Engines
WING'S Acetylene Generators, etc.

holders. The consideration was about $5,000.

Walter & Co., St. Peter, Minn., steam heating the C. Amundson Block.

Pittsburgh Heating Co., Pittsburg, Pa., installing the heating system in the new factory at Ford City, Pa. for the Pittsburg Plate Glass Company.

A. Baker, Leadville, Colo., heating the new telephone building. The heating system will be the direct-indirect radiation.

Henry A. Trautman, Columbus, Ohio, heating and plumbing the $30,000 business block and apartment building.

G. S. Blodgett Co., Burlington, Vt., hot water heating the new telephone building.

B. S. Knapp, Park Rapids, Minn., heating the City Hall in Perham, Minn.

New Prague Foundry Co., New Prague, Minn., steam heating the new St. Wenceslaus Church.

P. L. Maloney Co., Chicago, Ill., heating four apartment buildings for Pruitt & Moore.

Schuler Brothers, Wilkesbarre, Pa., steam heating the $40,000 apartment building and $30,000 Lawson Hotel for the Cumberland Realty Company.

Neumoyer Brothers, Macungie, Pa., installing the steam heating apparatus in the Central School at Reading.

Otto Biefeld & Co., Watertown, Wis., heating the new Sacred Heart Church in Sun Prairie, Wis.

H. C. Park, Ridgway, Pa., steam heating the Court House at Clearfield, Pa.

John Schilling, Columbus, Ohio, heating the guardhouse at the Columbus barracks.

S. Frith & Co., Philadelphia, Pa., installing the steam heating system in the Protestant Episcopal Divinity School, at a cost of $2,500 and a steam heating plant costing $1,000.

Abbott Brothers, Tuskaloosa, Ala., heating and plumbing the new Masonic Temple. The consideration is $3,995.

Robert Gordon, Chicago, Ill., installing a vacuum system of steam heating in the general office building and paint shop of the Santa Fe Railroad.

Evans, Almirall & Co., New York, heating and ventilating the new High School building at Haverhill, Mass.

Solberg & Colby, Minneapolis, Minn, heating All Saints' Church.

Thomas J. Douglas & Co., Chicago, Ill., steam heating a factory for the Price Baking Powder Company.

C. Dressehuys, Aberdeen, S. D., heating and plumbing the First National Bank Building.

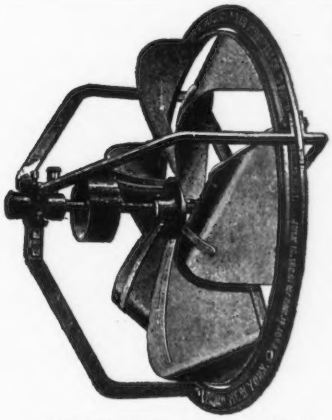
Charles A. Howard & Co., Annapolis, Md., heating the Presbyterian Church.

W. J. Schulman, Cincinnati, Ohio, heating the new Lyric Theater.

E. J. Harrington, Fargo, N. D., heating and plumbing the new Soo Hotel in Bismarck, N. D.

Modern Heating Co., Wilkinsburg, Pa., heating the new $30,000 church being built by the Wilkinsburg Baptist Church congregation.

Paul W. Beech, Jackson, Tenn., heating the public school building at Lexington, Tenn.



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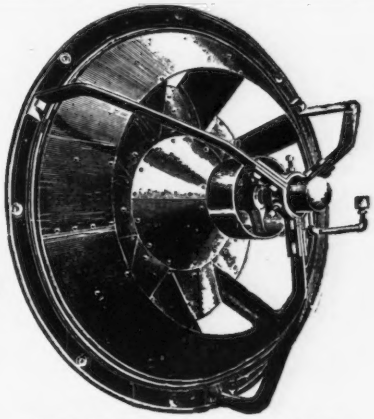

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MANUFACTURERS, ENGINEERS AND CONTRACTORS

O. S. Kendall & Co., Worcester, Mass., installing the heating apparatus in the new building for the Worcester Insane Hospital at Bloomingdale; also steam heating the Brewer Building on Commercial Street.

National Tube Co., Pittsburgh, Pa., furnishing twenty miles of pipe for the Texas Oil Company; also 285 miles of 6-inch wrought iron pipe for the Pure Oil Company.

T. H. Dexter, Providence, Mass., heating the First Congregational Church at Spencer, Mass.; also installing an exhaust steam heating system in the Prouty Shoe Factory, Spencer.

Irps Brothers, Chebanse, Ill., hot water heating the new State Bank.

F. A. Clegg & Co., Louisville, Ky., installing the pipe work in the new power plant of the Louisville Lighting Company, at their bid of $26,000.

Lewis & Kitchen, Chicago, Ill., steam heating the new buildings at the Soldiers' Home, in Marshalltown, Ia.

Sachs & Rynda, New Prague, Minn., heating the Catholic Church at St. Patrick, Minn.

Oliver Halverson, Harmony, Minn., heating the Catholic Church at Canton.

Peters-Eichler Heating Co., St. Louis, Mo., steam heating the 14-story office building on Eighth and Chestnut streets.

Dickson Co., Peoria, Ill., heating and plumbing the Pierson store and flat building.

Sedro Woolley Plumbing Co., Sedro Woolley, Wash., heating the school building.

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